Subterranea

The Magazine for Subterranea Britannica

Subterranea Britannica **December 2016 Issue 43**

IN THIS ISSUE

Portsdown Hill Magazines
Norwood Tunnel - Chesterfield Canal
Westcott Rocket Propulsion Establishment
Wilton Super Zero Station

Subterranea Britannica is a society devoted to the study of man-made and man-used underground structures and the archaeology of the Cold War. The society is open to all and its membership includes all walks of life. Members are invited to contribute to this magazine even if this just means sending very welcome snippets from newspapers and magazines.

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Front cover photo: The Operations Room for the Portsmouth District Council Emergency Centre and Hampshire County Standby Emergency Centre was located in the former underground magazines below Fort Widley on Portsdown Hill. The original barrel-vaulted magazine roof is seen here. The observation window from the controller's room on the upper level can be seen on the left. This room had a long curved Perspex window similar to those found in AAORs and Regional War Rooms of the same period. Photo Nick Catford

Back page upper: SubBrit member Steve Drake completes the long climb up the ladder out of Scout Mine, belayed by Scout group helpers Robin Kent, and John and Richard Wright. Photo Chris Rayner

Back page lower: Inside one of the 57 hutches at RAF Barnham. A hutch is a storage unit for fissile material; the radioactive material would have been stored in metal containers with heavy lids called 'safes', which were set into recesses in the floor slabs. A Type B hutch is seen here which, it is believed, was used for cobalt cores. Photo Chris Rayner

Newsletters of Subterranea Britannica are published by the committee of Subterranea Britannica. Original articles, book reviews, press cuttings, extracts from books and journals, letters to the Editor etc. are welcome. However the Editor reserves the right not to publish material without giving a reason.

The committee of Subterranea Britannica and the Editor do not necessarily agree with any views expressed and cannot always check the accuracy of any material sent in.

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Chairman's Welcome

Martin Dixon

I'm writing this fresh from our Autumn Conference in Belfast and associated visits across Northern Ireland. Although individual members have visited before (and of course we have some members whose home it is!), this is the first time that Sub Brit has had a formal visit here and we weren't disappointed.

We had some fascinating presentations and had a warm welcome at sites ranging from Victorian gas works to Cold War shelters. For me two highlights were the tunnel beneath the River Lagan Weir – a sort of mini Thames Barrier – and the hugely atmospheric Crumlin Road Jail, complete with a tunnel to the Court House opposite. See *Subterranea* 42 and the members' forum for descriptions and photos of the sites. It was a great chance to meet up with members old and new from across the country and compare experiences and news. Thanks are due to Chris Rayner and other members for all the time and energy they put into the weekend.

Thanks are also due to Sub Brit webmaster Richard Seabrook who has put so much effort into supporting and extending our web presence. Sub Brit's original website started over twenty years ago – three years before Google was even founded. Since then our online offering has multiplied and Richard has added the mySubBrit membership system, the members' forum, shop, archive and social media, alongside the original public site. We get over half a million unique visitors a year and our social media attract over 7,000 direct followers.

It's now time to find some more members to work alongside Richard in taking us onward. There is a flyer in this edition of *Subterranea* describing some of the roles we are looking to fill. I should stress that not all of these are technical and the ability to add new sites and news items is as important as the platform work that underpins it. Please consider volunteering to at least find out more – to paraphrase Lord Kitchener, **Your Society needs You!**

In November, I'm attending the annual SFES (Société Française d'Etude des Souterrains) Congress based in Arras, France (and hopefully will have attended by the time you read this!). SFES is broadly the equivalent of Sub Brit in France and having seen the conference publicised on the forum, around half a dozen Sub Brit members will be there; it promises to be a fascinating event. This time the sites we will visit include some of the fascinating *muches*, or underground villages, excavated in the Picardy area during the Franco-Spanish Wars of the 17th century.

Many of these were close to the front line in World War I and used by both sides during the conflict and thus abound with evocative graffiti in English and German. Other *muches* were used by civilians for shelter in WWII and a third language of signs and scribbling was added. I hope we will have a report in a future edition of *Subterranea*.

SFES is important to Sub Brit in both a general and particular sense. Generally, as I believe our international links are important in helping us understand commonalities and differences across our borders and they also give us access to some fascinating trips. More particularly, our founder Sylvia Beamon modelled Sub Brit on SFES under the tutelage of their then President Professor Raymond Mauny (1912–1994). Whatever your views on our trading relationship with Europe, Sub Brit's membership of a larger European subterranean community should be here to stay.

With seasonal good wishes, whether this is your first year with Sub Brit or your forty-first, and may your underground resolutions for 2017 be realised.

chairman@subbrit.org.uk

Surface Walk at Croydon

Surface-only walk in and around Croydon led by Paul Sowan to see the locations of (mostly inaccessible) underground sites. Meet at Wandle Park tramlink stop (westbound Wimbledon line trams, three stops from East Croydon Station) at **12.00 on Sunday 19 March**. Sites to be visited include Croydon's underground river, a medieval undercroft, the former Central Croydon Station area, the three former railway tunnels under Park Hill (traversed by tram), a modern high-voltage cable tunnel, the site of deneholes (medieval chalk mines), John Aubrey's 'caves' at Coombe and two covered reservoirs. Distance to be covered, on foot and by tram, about five miles.

Optional end-of-walk visit to Croydon's oldest operating pub. No hard hat or lamps needed! But wear stout shoes and warm clothing and have with you some means of paying for two or three tram rides. Historical details will be given at each site.

This is the first of an intended series of surface-only walks at underground sites around Croydon and east Surrey. The message is that to better understand an underground site it is essential to appreciate its geological, hydrological, geographical, historical, strategic and economic context.

No need to book - just turn up at the meeting place.

SUBTERRANEA BRITANNICA DIARY

Summary of Forthcoming Events

Sub Brit specific events

2017

21 January SB Committee meeting, Woking
4 February Site visit to RAF Barnham, Suffolk
1 March Copy deadline for *Subterranea* 44
18 March Site visit to Scout Mine, Reading
19 March Surface Walk at Croydon, guided by Paul Sowan
25 March Site visit to Clifton Suspension Bridge Vaults, Bristol
Mid-April *Subterranea* 44 published
22 April SB AGM and Spring Meeting, London
12 - 15 May SB Copenhagen Weekend
8 June Paddock Open Day
17 June SB Committee Meeting
1 July Copy deadline for *Subterranea* 45
Mid-August *Subterranea* 45 published
16 September Paddock Open Day
1 November Copy deadline for *Subterranea* 46
Mid-December *Subterranea* 46 published

Other underground-related events

2017

6 - 10 March Hypogea, Cappadocia
22 April South Eastern Industrial Archaeology Conference (SERIAC), Worthing
28 April - 1 May Railway & Canal Historical Society AGM, Exeter
2 - 10 May Fortress Study Group Malta Study Visit
11 - 13 May International Early Engines Conference, Elsecar, South Yorkshire
23 - 26 June NAMHO Conference 2017, Godstone, Surrey
25 - 30 August AIA Conference, Northamptonshire
2 - 6 September Fortress Study Group - Alderney Study Tour
7 - 10 September Heritage Open Days, England
16 - 17 September London Open House

For web links to these events please visit www.subbrit.org.uk/events
or contact the Society concerned

If you know of other relevant events run by other societies, please let us know so that they can be advertised in the next edition and on the website

Subterranea Britannica Annual General Meeting 2016 – Minutes

23rd April 2016, Lecture Theatre 1.31, Royal School of Mines, Imperial College, London.

The meeting was opened at 10.05 by the Chairman, Martin Dixon, who welcomed all those attending. 98 members were present.

1. Apologies were received from Bob Barnes, Ian Fazakerley, Mark Russell, Paul Sowan, S. Morgan, Terri Jones, John Poole, Richard Seabrook, Tim Wellburn, John Collett, Steve Underwood.
2. The Minutes of the AGM 2015 were published to all members in ***Subterranea*** *August 2015*. The Minutes were accepted by the meeting nem con. Proposed by Alistair Graham-Kerr, seconded by John Burgess.
3. Annual Report. This has been published to all members. The Chairman remembered the passing of a number of active members during the year. Where possible, short notices were published in ***Subterranea*** and condolences sent to relatives.

   Martin gave a short presentation highlighting the activities and achievements of 2015 including the grants which have been made to various underground-related projects. Martin thanked all those who had contributed to Sub Brit's continued success and gave specific thanks to the Committee and to Chris Wilkins who resigned from the Committee during the year.
4. Statement of Financial Activities: Sub Brit's Accounts have been signed off by the Independent Examiner and have been filed at Companies House and the Charity Commission.
5. The motion that nominations for Sub Brit's Committee be considered '*en-bloc*' was proposed by Stewart Wild and seconded by Sylvia Beamon. The motion was carried nem con.
6. The motion to elect the following Committee members for 2016/17 was proposed by Sam Marko and seconded by Andrew Smith. The motion was carried nem con.

   The elected Committee for 2016/2017 is:-

Martin Dixon	Chairman	
Richard West	Vice Chairman	
Linda Dixon	Secretary	
Nick Catford	Membership Secretary	
Tony Radstone	Treasurer	
Chris Rayner	Member	
Richard Seabrook	Member	
Paul Sowan	Member	
Bob Templeman	Member	
Tim Wellburn	Member	
Alistair Graham Kerr	Member	NEW
Jason Hughes	Member	NEW

The Meeting closed at 10.25.

Subterranea Britannica

Notice of Annual General Meeting 2017

The AGM will be held on Saturday 22 April 2017, commencing at 10.00am at the Royal School of Mines, London, in association with the Spring Meeting

***

Attendance is open to all current members of Subterranea Britannica

Documents for the AGM will be available on our website at www.subbrit.org.uk at least 28 days in advance of the meeting. An email will be sent to advise this. Documents will be sent to those members who have registered to receive them by post

Minutes of the AGM 2016 are printed above

Summary Minutes of Committee Meeting 8 October 2016 at Kelvedon Hatch, 10.30

By Sub Brit Secretary, Linda Dixon

Attendees:

Martin Dixon, Linda Dixon, Nick Catford, Richard Seabrook, Chris Rayner, Bob Templeman, Paul Sowan, Tim Wellburn, Jason Hughes. Adrian Armishaw was co-opted for the meeting, with a view to joining the committee next year. Apologies – Tony Radstone, Richard West, Alistair Graham Kerr, Chris Gray. Subsequent to the Committee meeting in June, Mike Scott is not able to join the Committee due to pressures of work.

Health and Safety.

This is a standing item on our Agenda. We agreed that Jason would attend a Confined Spaces training course and assess for other Sub Brit members.

Financial Review

Thank you to Tony for the budget for 2017. Committee agreed that the bank balance was healthy enough to sustain membership fees at current level. If we have to pay for layout of ***Subterranea***, then this would need to be reviewed.

Grants

More leaflets have been produced for Paddock visitors; grants have been made to Hemingfield colliery towards the restoration of the winding house; to Portadown ROC Post Museum for a display board and agreed in principle for the Post Office Railway. Other grants are in the pipeline – members are asked to let us know of other worthy projects.

Paddock

Bob Templeman will take over the organisation of Paddock visits for May 2017; Nick will still liaise with Katy and attend on the day. The 'Churchill' re-enactor was well received at the last Open Day and is to be considered again for the future.

Sub Brit Website

Richard Seabrook really needs some more help and support in order to keep the site more up to date. A flyer would be included in ***Subterranea 43*** to ask for help from members.

Day Meetings

We are looking forward to the Autumn Meeting in Belfast on 15 October, with 2 days of visits on Sunday/Monday 16/17. In 2017, the Spring Meeting is on 22 April at Imperial in London; the Autumn Meeting was decided as 14 October. Chris Rayner will investigate Nottingham for Autumn 2018.

Visits/Trips

We are still trying to pursue another trip to Gibraltar; we are hoping to try a new contact. Martin is trying for Copenhagen in Spring 2017; Portsmouth/IOW may still be a possibility for the UK weekend. See *Diary* for other trips.

Day Visits/Trips

Lots more trips are being investigated – these will be advertised via the email list or SubT if there is time. Three trips to RAF Barnham have been set up by Chris Rayner along with a trip to Caerwent; Martin is investigating Fort Southwick. If members have suggestions, then please get in touch.

Sub Brit Site Directory

Committee members will help with updates to this and we will ask our ***Subterranea*** printer for a 'fresher' look.

Robert Horsfall-Turner, 1931–2016

Robert Horsfall-Turner, a long-standing member of Subterranea Britannica, sadly died on 4 October 2016. A frequent attendee at Sub Brit meetings and events, usually accompanied by his son Alex, he was knowledgeable and approachable, with an eclectic list of interests.

Born in March 1931, Robert was raised in Ruislip and attended Merchant Taylors' School. After National Service with the Intelligence Corps in Germany he went to University College, London and qualified as a dentist. Retiring in 1996 at the age of 65 left more time for Robert's many interests, which included subjects as diverse as steam engines and poetry, old tools and walking the Chilterns.

Robert and Alex both joined Subterranea Britannica in 2004 and were regulars at our London meetings and AGMs. Robert also attended many trips and weekends, and his wide knowledge often helped enhance these for others. His face seemed to always sport a smile which we will all miss.

Robert's last Sub Brit trip was to RAF Daws Hill in July 2015. Shortly after this he became ill and later moved into a care home. He retained his thirst for knowledge until the end and ensured that *Subterranea* was redirected to his new home so he could continue to follow Sub Brit and our activities.

We send our deep commiserations to all his family and to Alex in particular.

MEMBERSHIP RENEWALS

Your membership of Subterranea Britannica runs out on 31st December; thank you for your support during 2016. If you'd like to rejoin the society then please ensure that you renew your subscription as soon as possible after 1st January – not before please, as it messes up our accounting.

We'll be sending out renewal reminders, but it would really help us if you could renew promptly; sending chasers by post costs us effort and money.

If you have previously ticked the box to allow us to claim Gift Aid on your subscription then many thanks. But do please remember that you have to notify us if your tax situation changes.

To renew, go into 'mySUBBRIT' and click on 'Renew membership';
or send your details and a cheque to
Tony Radstone, Buckby House, Wharf Lane, Bourne End, SL8 5RS

NEWS

Miscellany compiled by Paul Sowan and Nick Catford

NEWS – HEALTH & SAFETY

CCTV film shows tourists dive for cover in tunnel they thought was abandoned – as a train approaches

Shocking CCTV footage shows the moment two Irish tourists narrowly avoided death after wandering down a tunnel – unaware that a train was approaching them in the darkness. As the train hurtles towards the entrance, at Downhill, Derry, in Northern Ireland, a lifeguard from the nearby beach, who spotted the pair go inside, can be seen waving frantically near the tracks to warn the driver.

Unable to stop in time, the train enters at considerable speed; at which point CCTV reveals two figures who had been walking next to the tracks desperately diving to get out of its way. Incredibly, the pair, believed to be tourists from the Republic of Ireland in their forties or fifties, escaped with just a few scratches.

Left, the lifeguard is seen attempting to stop the train. Right, the tourists are seen in the tunnel jumping clear of the train

The lifeguard at the scene, Ray Cunningham, said he 'feared the worst' as he watched the drama unfold. 'When I talked to them, they said they were using it because they thought it was abandoned or not in use.'

Translink Northern Ireland Railways, which operates buses and trains in Northern Ireland, released the footage, taken in July 2015, to warn the public of the dangers of going anywhere near the tracks. Between April and August this year, there was more than one incident a day where pedestrians took serious risks on the railway network. These included a near-miss involving a child playing chicken on the tracks.

SOURCE: *MailOnline,* 22 September 2016

NEWS – ARCHAEOLOGY

Snorri Sturluson's subterranean passageway to his hot bath at Reykholt, Iceland

An exceptionally early adaptation of geothermal energy in Iceland in the early years of the thirteenth century has been investigated at Reykholt in the Borgarfjörður, western Iceland, the former home of Snorri Sturluson, who died in 1241. That gentleman, famous in Icelandic literature of the time, created his own hot bath at a natural hot spring near his farm and, for his additional comfort, had made a subterranean passage from his house to his bath.

Some details of these features are noted in an archaeological report published by the National Museum of Iceland in Reykjavik and reviewed in the journal of the Viking Society. Place-names commencing with *Reyk-* in Icelandic signify locations where natural steam issues from vents and hot springs and geysers.

Interestingly, apart from locations at hot springs where Icelanders once did their clothes-washing, there seems to have been no further attempt to harness the country's abundant free hot water until World War II or just after, when the City of Reykjavik created a hot water mains system in parallel with cold water mains as familiar to us all in the rest of Europe.

Since the last World War there have also been attempts, with limited success, to build and operate geothermal power stations. These were hardly an urgent need as Iceland has abundant supplies of inexpensive electricity from numerous hydroelectric generating stations.

SOURCE: CALLOW, Chris, 2016, Review of '*Reykholt: archaeological investigations at a high status farm in western Iceland'* by Guðrún Sveinbjarnardottir in *Rit Þjóðminnjasafns* 29 (2012) [ISBN 978-9979-790-35-8] *Saga-Book of the Viking Society for Northern Research* 40, 105–106.

Archaeologists discover 200-year-old underground pub in Manchester

Archaeologists have discovered a 200-year-old underground pub during building work on a office building in central Manchester. Excavators discovered untouched bottles full of brandy and crockery branded with the eighteenth-century landlord of the *Astley Arms.*

Archaeologists were brought to the site of a future 13-storey skyscraper as part the planning process and found the remains of houses as well as the pub. Some of the recovered pottery items were inscribed with the name of Thomas Evans, the pub's landlord in 1821.

According to local historians, the pub was renamed *Paganini Tavern* in 1840 before returning to being called

Astley Arms and remaining open until 1928. Some of the recovered items will be displayed at the city's Museum of Science.

SOURCE: *The Independent,* 27 September 2016

Water tunnel found under Mayan king's tomb

Mexican archaeologists have discovered a canal network underneath the 1,300-year-old Temple of the Inscriptions in the ancient Mayan city of Palenque. Experts believe the water flowing through the underground tunnels beneath the tomb of the Mayan King Pakal was meant to offer a symbolic path to the afterlife.

Shrouded in the dense jungle of the southern Mexican state of Chiapas, the Temple of the Inscriptions was one of the most complex construction projects ever undertaken by the Mayans, and for hundreds of years the stone pyramid that towered over the ancient city of Palenque concealed a secret deep inside.

Since the tunnels – two feet wide and two feet high – were too small for human exploration, the archaeological team relied instead on cameras and lights mounted on small wheeled vehicles that were driven along the limestone floors of the canals by remote control. They discovered the intricate canal system has various levels and flows in numerous directions.

The archaeologists believe the canals existed well before the pyramid itself, possibly as part of a drainage or water supply system in Palenque. Since water is still flowing through the underground tunnels, the source is likely a natural spring.

SOURCE: *History in the Headlines,* 26 July 2016

NEWS – CONSERVATION AND HERITAGE

Planned Mining Museum at Betteshanger colliery site, Kent

There are plans to open a Kent Mining Museum at the former deep coal mine site at Betteshanger, a few miles inland from Deal on the east Kent coast. A 'state of the art' visitor centre is planned to open in Spring 2017, and an adjoining museum in the following summer.

The shafts to the coal seams are exceptionally deep, and the mine almost certainly flooded, so no underground visit is ever likely to be possible. The published announcement gives a telephone number, 01304 619227 for those wishing to have further information.

Your scribe visited the Betteshanger Colliery twice when it was still actively mining coal, some years before it closed, and also Chislet, and adds the following information.

Betteshanger colliery shortly after closure. Photo Nick Catford

The existence of coal at economically workable depths in southern England was suggested at least as early as 1850 by R.A.C. Godwin-Austen of Guildford, Surrey. After a series of deep boreholes had been sunk in Kent, Surrey and Sussex, coal seams were eventually located in 1890 at a depth of 1,100 feet below the former Channel Tunnel site at Shakespeare Cliff between Dover and Folkestone.

Although a shaft was sunk at that location it proved to be uneconomic to mine coal commercially, and the works were abandoned. A later proposal to mine ironstone from shallower depths in this shaft was also abandoned.

SOURCE: ANON, 2016, Mining for information. *Group Travel Organiser,* September / October 2016, page 14.

China's 816 Nuclear Military Plant reopens to the public

The 816 Nuclear Military Plant in southwest China's Chongqing municipality has reopened its doors to the public, after a year of modification works.

This abandoned nuclear plant has been regarded as the world's largest artificial cave and the country's only

former nuclear engineering site that has been opened to the public as a tourist attraction.

Local officials state the site will offer a perfect integration of history and modern technologies after the reconstruction efforts. The site will also implement sound and lighting effects as part of its update in order to create a better sense of participation for visitors.

The 2001 process pipelines in the nuclear reactor hall have been restored, and are designed to demonstrate the process of nuclear fission through the photoelectric effect.

Construction of the China 816 Nuclear Military Plant, once a highly confidential military site in the mountainous town of Baitao in Fuling District, began in 1966, but the Central Military Commission called off the project in 1984 because the situation in the world was relatively peaceful at the time.

The cave was designed to withstand thousands of tons of explosives and even 8.0 magnitude earthquakes.

SOURCE: china.org.cn, 26 September 2016

New visitor centre at Spiennes Neolithic flint mines near Mons, Belgium

The Belgian city of Mons (known as Bergen in the Flemish-speaking part of the country) has, astonishingly for its population of 100,000 persons, three World Heritage Sites as designated by the United Nations Educational, Scientific and Cultural Organisation (UNESCO).

The flint mines at nearby Spiennes were added to the list in 2000, and the city has, with the assistance of the European Regional Development Fund, built a circular steel and glass visitors' centre from which the public can see the 100-hectare site containing thousands of prehistoric mine shafts.

This centre, named Silex's, was opened to the public in April 2015, and featured public access by way of a fixed steel ladder to a flint mine excavation around 16 metres below ground level. Silex is the French word for flint. Access to the surface between 10.00 and 16.00 costs €6 for adults, and an additional €8 for access to the centre and underground.

It appears that the underground visits are for groups of up to ten persons at a time, and last one hour 30 minutes which presumably includes safe supervised

descent of the fixed steel ladder. For up to date details and how to make reservations see www.silex.mons.be or www.polemuseal.mon.be .

It is interesting to compare modes of public access to the Spiennes mines, which were dug from rather narrow shafts, with similar sites at Grimes Graves in Norfolk, where the shafts are much wider, and with the Dutch and Polish mines which can also be visited.

When your scribe was last at Grimes Graves, access was and perhaps still is by a steeply inclined steel ladder, and it was necessary to crouch down to be able to see into the low mine tunnels at shaft floor level.

At Rijckholt–St. Geertruid in the Netherlands an entirely different approach has been adopted. A concrete-lined horizontal tunnel has been driven from the hillside at the appropriate depth to allow visitors to see through 'windows' into a number of lighted tunnels whilst standing in comfort.

At Krzemionki Opatowskie in Poland an entirely modern shaft has been sunk and accommodates a conventional steel staircase with landings, this giving access to a circular gallery from which, again, visitors can view the mine galleries through windows at a convenient height. There are more or less impressive associated surface displays in buildings at Grimes Graves, Krzemionki and, now, Spiennes, but not at Rijckholt where visitors should visit the flint mining gallery in the museum at nearby Maastricht. SEE ALSO the notice of the Spiennes guidebook in the **Publications** entries below.

Aberlemno ROC Post being restored by two teenagers

Aberlemno's Royal Observer Corps post, north of Dundee, was to open to the public at the end of October, 25 years after the ROC was stood down.

The bunker has been the subject of ongoing restoration work by Lachlan Macleod and Ronnie O'Rourke, who started work at the site last year. Both have lived in Aberlemno for most of their lives and have an interest in the history of the site. They started restoring the bunker after approaching the landowner, who was happy to let them take it on.

So far, the project to restore the site has been helped by

the local community and fellow restorers in Angus – including Jim Sherrit who is restoring the Edzell post. Lachlan explained: "We get help from local ex-members of the Royal Observer Corps who served in these posts. A lot of the stuff we have to reproduce ourselves because they're either hard to get or ridiculously expensive."

The work to restore is largely being done by the duo during the weekend, as Ronnie attends Brechin High School and Lachlan is about to start at college. Lachlan added: "We've had some helped from Mr Coates, the history teacher at Brechin High School. We've even got some of the teachers coming to a fund-raising quiz night to help support us."

The Aberlemno post was active between 1961 and 1968. Lachlan and Ronnie are aiming to restore the site and open it as a visitor attraction. The duo's project is also part of the Crowdfund Angus scheme. The boys hope to raise £1000 to buy equipment such as a generator, radio and a bed.

Describing the project on the Crowdfunder website, Lachlan explained: "Very few people ever realised that these bunkers were scattered across the country, but we hope that we will be able to turn the bunker into a community visitor attraction and educate the public. This will not be possible without your support, as getting hold of the old equipment, buying consumables, advertising and just keeping the post in good, dry condition is a very costly business."

Information and updates on how the restoration is progressing can be found at www.facebook.com/groups/797092893749908/

SOURCE: *Brechin Advertiser,* 29 September 2016

NEWS – MILITARY AND DEFENCE

Goodbye SRHQ 4.2

The bunker underneath Sovereign House in Hertford has been filled in. The plans originally lodged at the planning department showed the bunker being preserved and used as parking with a car lift for the flats which would be built above. Later plans show the new building without an underground car park. The basement of Sovereign House contained the Home Office regional government bunker known as SRHQ 4.2.

The basement after demolition of the building. Photo Howard Martin

SOURCE: Howard Martin

British-era bunker unearthed in India

A forgotten 150-metre long, underground British-era bunker has been unearthed inside the sprawling Raj Bhavan complex at Malabar Hill in south Mumbai, India.

In spring 2016 some elderly people informed the Governor of the existence of a tunnel inside the Raj Bhavan on the shores of the Arabian Sea. He asked to get it opened.

The bunker was opened on August 12. What was believed to be an underground tunnel turned out to be a huge barracks with 13 rooms of varying sizes spread over an area of more than 5,000 square feet. The underground bunker opens with a 20-ft tall gate and a ramp on the western side. There are long passages connecting small to medium rooms on both sides. The bunker has two mini-staircases, leading to speculation of another floor which is still to be explored.

The story behind the bunker is presumed to date back to 1875, when the Prince of Wales (who later became King Edward VII) visited Bombay. He visited the Malabar Hill bungalow, then the summer residence of the Bombay governor. It was for his visit that the banquet hall was expanded to build a ballroom and the bunker for anticipated security concerns, officials at the Raj Bhavan said.

The bunker is being called a war-room based on decayed nameplates that read Shell Store, Gun Shell, Cartridge Store, Shell Lift, Pump and Workshop and there are scores of Lamp Recesses in the tunnels. (*Editor's note*:

these names clearly indicate that this was the underground magazine for a gun battery.)

Presumably closed after Independence, the whole area is now covered with wet mud and stones owing to the lawns above the bunker. The ventilation shafts on the roof of the bunker have let water and mud seep in during the many monsoons the historical bunker has withstood.

Officials have also found broken air-vents on the floor of the stone-path. An 1868 site map shows the presence of a structure with five vents seen in the lawn. The state government plans to explore the possibility of turning the bunker into a tourist attraction.

In October 2010, a huge and well-maintained tunnel believed to be over two centuries old was discovered in the premises of Mumbai GPO.

SOURCE: *Business Standard*, 16 August 2016 & *Hindustan Times*, 17 August 2016

Public air-raid shelter in Keighley, Yorkshire, filled in

A historic underground air-raid shelter has been filled in ahead of demolition work starting on Keighley's former college in late 2016. But contractors first had to rid the site of the shelter, which was discovered three years ago beneath the old college car park.

The shelter was brick-built with a reinforced concrete ceiling, was about three feet wide and had four linked corridors in a rectangular layout. Wooden benches were largely rotted but there was still evidence of the wall fixings. Some of the floors were covered by wooden boards to keep people's feet off the cold concrete floor.

The structure was uncovered, about three feet below ground, during demolition of an unwanted boiler house in the car park. The shelter, which was not included on the building's plans, was resealed pending a decision on the site's future.

The shelter was recorded for Keighley archives. Other such shelters existed under Town Hall Square and beneath the Oakworth Road roundabout.

In July this year councillors approved plans for the ex-college block, which has been vacant for six years, to be demolished and replaced with a £19 million 'hub' for council and other services. The building had been marketed for some time, but without success.

SOURCE: *Keighley Times*, October 2016

ISIS forces in Iraq retreat into tunnels to evade capture

ISIS forces constructed a network of underground tunnels in an Iraqi village to avoid detection in the final throes of battle. Jihadis were forced below ground as they lost the initiative in the fight for the village of Mufti, in the Kurdistan region of Iraq.

An ISIS fighter blew himself up when Kurdish Peshmerga forces, which have pushed the jihadis back 50 miles in six days, followed them into the tunnels. Mufti had been under ISIS control since the summer of 2014 but was liberated in June 2016.

Kurdish Peshmerga soldier inspects a tunnel system constructed by ISIS beneath the small hamlet of Mufti

A US B52 heavy bomber hit one house exposing the network of tunnels which ISIS had used to escape coalition detection. Some of the tunnels were 10ft deep – with the system spread out across a quarter of a mile. Fighters had dug out the labyrinth of underground corridors and hid the mounds of soil inside a neighbour's house. The jihadis had enough supplies to stay underground for weeks – with large quantities of medicine, water and food.

The tunnels meant ISIS snipers could confuse Peshmerga forces by positioning themselves behind their frontline.

SOURCE: *MailOnline*, 5 June 2016

Toronto's 1960s nuclear control centre is for sale

A Cold War bunker sits hidden underground in the yard of an 1870s farmhouse in Aurora, 31 miles north of Toronto. The 35′ x 60′ room was built as Toronto's nuclear control centre in the 1960s when threats of hydrogen bombs kept a nation on edge.

Hand-drawn maps of the GTA, boards to calculate the casualties, emergency water tanks and 100 telephone lines are some of the original artefacts that remain. In the case of a Cold War bombing, officials would have directed rescue operations from within the preparedness centre.

The current owner, Werner Brodbeck, purchased the home from the city in the 1990s when Toronto council was selling off several properties. Although they have decided to sell now, they want to make sure the property's historical value is protected.

The homeowners have applied for provincial historic designation for the home and the bunker. They hope to receive that designation within the next couple of months, before the home sells. The house is listed for $1,595,000.

SOURCE: *Toronto City News*, 15 August 2015

Russia is building new underground nuclear command posts

Russia is building large numbers of underground nuclear command bunkers in the latest sign Moscow is moving ahead with a major strategic forces modernisation program.

U.S. intelligence officials said construction has been under way for several years on "dozens" of underground bunkers in Moscow and around the country.

Russia's new national security strategy, which was made public in December, discusses increasing civil defences against nuclear attack, an indication Moscow is preparing for nuclear war.

Russia is engaged in a major build-up of strategic nuclear forces, building new missiles, submarines and bombers. A State Department report on Russian activities under the New START arms treaty stated in the spring that Moscow added 153 strategic nuclear warheads to its arsenal under the treaty.

The increase in warheads is said to be the result of the deployment of new SS-27 Mod 2 intercontinental ballistic missiles with multiple warheads and SS-N-32 submarine-launched missiles.

In addition to new missiles, Russia is building a drone submarine, code-named "Kanyon," which is said to be designed to carry a megaton-class warhead. Moscow also is moving ahead with a hypersonic strike vehicle designed to deliver nuclear warheads through advanced missile defence systems.

Military analysts say possible U.S. responses to Russia's underground nuclear complexes include the development of deep-penetrating nuclear bombs capable of placing Russia's command structure at risk. Another option proposed by nuclear experts is to develop low-yield nuclear arms that could be used in precision strikes.

Few details about the new nuclear underground bunkers were disclosed. State-run Russian press reports have said underground bunkers are being built in Moscow as part of the strategic forces build-up. Russia's Defence Ministry revealed in January that a modernized command and control system will be delivered to strategic forces this year.

SOURCE: *The Washington Free Beacon*, 15 August 2016

Cold war establishment under the ice, Greenland

Camp Century, a top-secret USA military establishment, was constructed by the US Army Engineering Corps about 120 miles inland from the coast of Greenland in 1959. The two-miles network of tunnels, evidently bored in the rock below the ice cap, accommodated laboratories, a shop, a hospital, a chapel, and up to 200 soldiers.

Officially, the purpose of this establishment was to test construction techniques in Arctic conditions, and carry out research of an unspecified nature. In reality, the purpose was reportedly a sub-glacial launch site for nuclear missiles aimed at the former Soviet Union. The cited reports plan for, ultimately, 'about 2,500 miles of icy underground tunnels and chambers extending over an area about three times the size of Denmark which would have housed 600 ballistic missiles, in clusters four miles apart, trained on Moscow and its satellite states'.

Seemingly, the plan was abandoned as unworkable on account of the glacial ice flowing, which is what glacial ice does; a fact already very well documented a century earlier! The weight of snowfall on the higher parts of a glacier force the already consolidated ice to flow downhill, in Greenland resulting in the lowest parts breaking off and floating away as icebergs. Camp access tunnels through the ice would inevitably be continuously distorted, as the millions of tons of ice are not going to remain static. From 1964 the base was manned only intermittently, and abandoned altogether three years later.

The entrance to Camp Century

When constructed, the base lay under twelve metres of ice, which has subsequently thickened to 35 metres. Studies of climate change now suggest the thickness of the ice cover will continue to increase for some years,

then start melting away as a result of established global warming trends. Spring and summer temperatures in Greenland broke records in 2016, reaching 24° C in the capital, Nuuk. Between 2003 and 2010 the Greenland ice has been melting twice as fast as during the whole twentieth century. In 2016 melting began a month earlier than usual.

At this rate, it seems increasingly likely that all the ice above Camp Century will eventually melt away down to bare rock, perhaps by about 2090. An abandoned establishment which it was thought would be hidden for ever would be laid bare, posing environmental risks on account of toxic waste left in the tunnels. There are thought to be 200,000 litres of diesel fuel, similar quantities of waste water, 'unknown amounts of radioactive coolant' and toxic organic pollutant such as PCBs still present. The 'reaction chamber of the nuclear generator', fortunately, appears to have been removed in 1967.

Who will foot the bill for preventing massive pollution of the Arctic region in or about 2090 is an interesting question. The then government of Denmark permitted work at Camp Century in 1951, but seems not to have been fully informed of the full scale or purpose of the project. Greenland, formerly a Danish county, became largely self-governing in 1979. The report concludes that 'the multi-national, multi-generational' problems 'could become a source of mounting tension between the US, Greenland and Denmark'. The Pentagon has said it 'acknowledges the reality of climate change and the risk it poses' for Greenland. Washington has pledged to 'work with the Danish government and Greenland authorities to settle questions of mutual security'.

Two photographs accompany the cited source. One shows three persons testing an escape hatch protruding from the ice in 1962. The other shows a crane positioning the nuclear plant's waste tank into place. The article draws on a report published in August 2016 in the journal *Geophysical Research Letters*.

SOURCE: HENLEY, Jon, 2016, Base beneath Greenland ice threatens to reveal its toxic secrets. *The Guardian*, 28 September 2016

German bunker found on Serbian construction site

Workers constructing a supermarket for Lidl in Belgrade have uncovered a well-preserved bunker, seemingly dating back to World War II, when the Nazis occupied Yugoslavia.

Local people believe the bunker was built during the German occupation of Yugoslavia in World War II. There are at least three levels, but it is possible there were more. "It looks like that with further digging, more levels will be discovered," a worker on the site said.

The Vidikovac bunker is not the only World War II bunker found in Belgrade. Two are quite visible, one close to Savska Street, in central Belgrade, not far from the city's main railway station, and another on the Sava

river bank. According to media reports, the latter is due to be destroyed, paving the way for the giant Belgrade Waterfront redevelopment plan. It remains to be seen what will happen with the latest bunker.

According to the construction plan, any underground objects found on the construction site are to be dug out and destroyed.

SOURCE: *Balkan Insight*, 11 August 2016

Israel to build an underground wall to deter Hamas tunnelling

Israel may be constructing an underground wall to deter Hamas's construction of tunnels from Gaza into Israel. The wall would stretch both above the ground and under it and run about 100 kilometres along the southern Gazan border. Israeli news outlet *Yediot Ahronot* reported that though the project was rumoured to cost tens of billions of shekels, the updated version of the project will cost 2.2 billion NIS (around $730 million).

In May and April this year, two new tunnels were discovered by the Israel Defence Forces, the first since the conflict between Gaza and Israel in the summer of 2014. The tunnel discovered in April was reportedly between 30–40 metres underground and extended dozens of metres into Israeli territory.

Hamas's terror tunnels were focal points of Operation Protective Edge in 2014. The wall is one of the initiatives that was then promised to residents concerned about their future security.

Officials from the Israeli defence ministry have been largely silent on the project's progress, declining requests for comment. However, a senior official said that, though a future confrontation with Hamas is inevitable, it must be the last one.

Various terror groups in Gaza, including Hamas, responded to news of the wall's construction by saying it would not limit their ability to carry out attacks on Israel. Hamas official Ismail Radwan said, "The resistance is able to adapt to all circumstances for the sake of continuing its project to liberate [Palestine]."

Similar construction efforts are under way along Israel's

The tunnel is 30 – 40 metres deep

border with Lebanon, where a fence already exists. These new defence efforts were galvanized by a recent announcement from Hezbollah leader Hassan Nasrallah, claiming that Hezbollah is planning to attack the Israeli towns adjacent to the border.

The Israeli military has provided estimates that Hamas spent around $30 to $90 million, and poured 600,000 tons of concrete, in order to build three dozen tunnels.

SOURCE: B'nai B'rith Canada, 21 June 2016

Underground bunker full of weapons uncovered in Kiev

An underground bunker with a large arsenal of weapons and an armoured personnel carrier (APC) has been uncovered by Kiev prosecutors jointly with National Police officers outside Ukraine's capital in Boryspilsky district, Kiev region.

The arsenal stored by a private household included Grad rockets, shells, mortars and anti-tank mines. Law-enforcers found 60 objects looking like Grad rockets, two items looking like shells for an infantry fighting vehicle, four items looking like ammunition to a portable anti-aircraft missile system, about 200 items similar to anti-tank mines, a tripod-mounted man-portable antitank gun, a bazooka, and armour-piercing shells. An investigation is underway to determine the channels of the supply of the weapons.

SOURCE: Unian Information Agrncy 4, November 2016

NEWS – MINES AND MINING

Stabilisation of abandoned mines and the role of power station ash

There are now no deep coal mines working in Britain, although large opencasts for the fossil fuel continue in business for the time being, although their days too may be numbered. Coal-fired electricity generating stations, too, are dwindling in numbers. The station at Aberthaw in the Vale of Glamorgan is planned to 'downgrade operations' from April 2017: it will generate current 'only when needed' which means predominantly during the winter.

With all deep mines now closed, there is of a course a huge number of abandoned shafts and mine galleries, generally unmonitored, lurking at depth, constituting a long-term hidden hazard. To render abandoned and unstable mine workings safe, backfilling with pulverised fuel ash (PFA) is a key requirement, but of course the supply of this commodity is coming to an end as coal-fired stations close. Such stations as still operate consume coal from opencast pits or abroad. But the overall trend is to abolish fossil fuel power stations altogether, to reduce carbon dioxide emissions and thus mitigate climate change.

It is a key feature of any successful industry that any by-products should find a market and be sold, rather than expensively tipped to waste. In the 1940s and 1950s PFA was tipped in old opencast pits, where it potentially posed water supply pollution problems: such a tip alongside the A22 at Godstone, east Surrey, for example, had to be chemically treated to eliminate toxic hydrogen sulphide gas generated within the ash.

PFA is not in fact so much as pulverised ash, as the ash resulting from burning pulverised coal in the power station boilers. The coal is ground to very fine powder and then blown into the furnaces.

There is of course a parallel problem concerning sulphur dioxide in power station flue gases, resulting from the oxidation of iron pyrites (iron II disulphide) commonly found in many sorts of coal. This grossly polluting acidic gas, a cause of 'acid rain', is now removed by reaction with lime (calcium carbonate) from opencast limestone pits. It is thereby converted into gypsum (known in the trade as de-sulpho-gypsum), the most important use of which is the manufacture of plasterboard for cheap or temporary building works.

When de-sulpho-gypsum, cheaper than mined gypsum, was readily available, gypsum mines were at least partially 'mothballed' or worked with reduced production, as for example at the mines in East Sussex. But as coal-fired electricity generation is steadily reduced, the gypsum mines look set to increase production to meet demand. As ever, one change in the industrial scene results in changes elsewhere.

SOURCE: EYNON, Matthew, 2016, PFA & the circular economy … the decline in coal-fired electricity production will have a knock-on effect on mine-works stabilisation. *Geoscientist* 26(7), page 9 [With added information concerning sulphur]

Death of Richard Budge, and deep coal-mining in the UK

Richard John Budge, sometime chief of the post-privatisation RJB Mining company (later UK Coal) died on 18 July 2016. He was born in 19 April 1947, coincidentally the first year of the National Coal Board which was established by Act of Parliament in 1946. His business career, initially with his brother, commenced in the building industry, but he acquired his interest in privatised coal mining in 1994. He took control of three of the five parts of the state-owned coal industry which comprised at the time seventeen pits, associated land, and opencast interests.

After some initial success, assisted by a commitment by the electricity generating industry to buy more coal, Budge's business failed, and he was sacked as chief executive with a golden handshake of £1m. The company was renamed UK Coal. The mines were over-stocked, with coal marketed at above world prices, and fossil fuel-fired power stations were subjected to increasing environmental protection regulations. Budge then purchased and reopened the deep Hatfield colliery near Doncaster with the intention of building the UK's first 'clean' coal-fired generating station beside it.

This business collapsed and went into administration in 2003 with Budge subsequently declared bankrupt in 2013. UK Coal closed the last deep mine in the UK, at Kellingley in North Yorkshire, in December 2015.

SOURCE: BUDGE, Richard John [1947–2016], Richard Budge: businessman who strove in vain to rescue the remnants of the English coal industry. *The Guardian*, 5 August 2016, page 35.

Emergency Mobile Winder donated to National Mining Museum

With the closure of the last producing deep coal mine in the UK, an Emergency Mobile Winder has been given to the National Mining Museum, Caphouse Colliery, Wakefield and is now permanently stationed on the pit's Emergency Winder pad.

It is one of two trailers; the other carries a power generator. A tractor has also been donated. The former NCB's emergency large-diameter hole boring rig (Minas) is also stationed nearby but in private hands.

SOURCE: *Below* (Journal of Shropshire Caving & Mining Club), Autumn 2016

Wallingford-Back mine, Canada

A spectacular photograph supplied by Getty Images, evidently taken just inside a cavernous mine entrance, has been published accompanied by the following caption. 'Locals refuse to cave in on mine's fate. A group of residents in Quebec is seeking to reverse an order to demolish Wallingford-Back mine, famed for its crystalline rock and cathedral-like voids, following concerns about visitor numbers to the disused site'.

A photograph shows a person standing, possibly on snow or ice, inside a huge day-lit cavern with a massive icicle hanging from the ceiling. What the mine was worked for, and when, and its exact location are not stated.

SOURCE: *The Guardian*, 6 October 2016, page 25.

NEWS – MISCELLANEOUS

Downloadable LIDAR maps of UK available free

LIDAR images for selected parts of the UK are being placed on the internet by the Environment Agency, and can be downloaded free! LIDAR is a remote sensing system which 'maps' the ground surface rather than the tree canopy, so reveals humps and bumps in woodland such as indicate mine shafts and spoil tips, crown hole collapse craters &c.

About 70 percent of England has now been scanned. An Open Government Licence means that from September maps can be downloaded for any legitimate purpose without payment. Visit http://tinyurl.com/EnglandLIDAR

SOURCE: *Descent* 245 (August / September 2016), page 4.

Museum of London to expand into a disused underground market

Plans have been unveiled for the new Museum of London which will see its vast collection put on show in a series of underground chambers beneath the streets of Smithfield.

A blueprint for the redevelopment of a group of buildings in West Smithfield, including the disused general market and fish market, has been developed by architects Stanton Williams and Asif Khan, who won the competition to design the museum's new home.

A dome on top of the general market, which has been closed for more than 30 years, will be lifted up to provide a landmark directly above a set of spiral escalators that will twist down underground, carrying visitors into the rooms used to store produce when it was a working part of the market.

The plans, which are still to be finalised, also include proposals to link the spaces below ground with a tunnel going under the Thameslink tracks that run under the site, a sunken garden and a well reaching down to the waters of the River Fleet, which flows beneath the streets of Farringdon.

A railway siding, from the days when meat was transported to the market from the docks, still exists and could become home to a historic engine, reflecting the importance of the railways to London's growth.

Architect Paul Williams, of Stanton Williams, said the design was influenced by "the idea of going down into the

The general market at Smithfield

sedimentary layers of the past". He said the move would protect the museum's collection from light damage and "free up" the site above ground to become "an amazing platform for the museum".

Replacing the current museum in London Wall will allow all of its collection go on show. An application for planning permission is expected to be submitted in 2018 with the museum set to open in 2022.

SOURCE: *Evening Standard,* 28 July 2016

Surprise discovery in Sittingbourne back garden

A family were shocked to make a historical find when digging up their back garden. Hannah Raistrick and her husband Tony were planning to landscape their lawn when they came across a large patch of concrete under an oddly-shaped flower bed.

After pulling the concrete up, their crowbar disappeared into a large opening at their Gore Court Road, Sittingbourne garden. They immediately stuck a camera down the hole and found a broken staircase leading down to the right. Moving their digging to the top of the staircase, and creating a huge hole, Hannah sent her father, Steve, down the narrow gap and into the chamber.

They discovered a four-metre hallway leading to a small round room with a dome, which lies directly under their children's climbing frame. Hannah's initial thoughts turned to it being an ice house, as it seems too small to be an air-raid shelter, and the bricks matched those used to build their house.

It is also possible it could be from the old site of Gore Court House, which was demolished in 1926 before their house was constructed in the 1930s. The family plan to cover up the entrance for safety, but still keep it accessible.

SOURCE: *KentOnline,* 31 August 2016

Newgrange, Ireland

If you die tomorrow, your executors can expect the bill for the funeral to be around £4,000 or so, whether you are sent up a chimney or on your last underground trip. It would be interesting to be able to price the grandest ancient and prehistoric funerals in modern terms: how much would an average pyramid cost for example, even without embalming, grave goods, and so forth?

Members who attended our splendid study weekend in Jersey will recall the lesser although still very impressive prehistoric burial mound on a hilltop, and exploring the built-in burial chamber. All the earth and all the rocks had to be carried or hauled to one of the highest points on the island.

The World Heritage Site passage tombs at Newgrange, built around 5,000 years ago in a loop of the river Boyne, are at least as awe-inspiring. Here, there are three such built mounds with internal burial tunnels, set in 780 hectares of archaeological landscape. The site was visited recently by the Newcomen Society, whose members' interests are generally in more modern structures, machines and devices such as anything from early steam engines to early and modern mobile telephones.

The Newgrange tombs are thought to have gone out of use about 2,900 BC, and first aroused modern interest in 1699. The largest passage grave has been described as 'probably the oldest deliberately aligned structure in the world'. A 'skylight' allows a beam of sunlight to illuminate the central chamber on six mornings around the winter solstice, 21 December.

The entrance passage has a length of 19 metres; visitors walking through can see 'spectacular artworks' inscribed into the rock – spirals, lozenges, triangles and so forth.

SOURCE: TAYLOR, Robert, 2016, Newgrange, Brú na Bóinne. *Newcomen Links* 239, page 25

[SEE ALSO: www.newgrange.com]

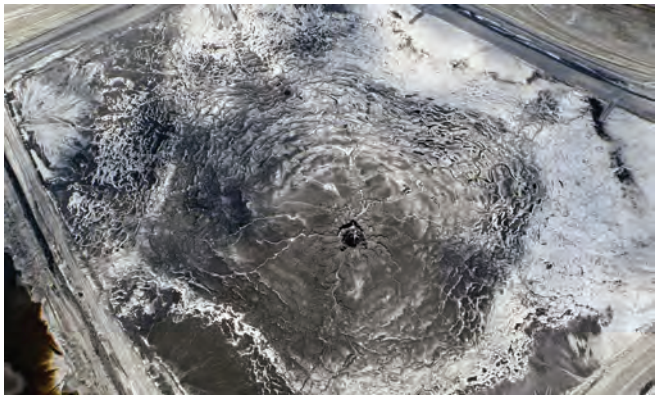
Sinkhole leaks radioactive water into Florida's main source of drinking water

A massive sinkhole at a Florida fertilizer plant has caused more than 200 million gallons of radioactive water to leak into a main source of the state's drinking water.

The sinkhole, which measures 45 feet in diameter and is 300 feet deep, opened up beneath a pile of waste material at Mosaic Company, the world's largest supplier of phosphate. A storage pond containing 215 million gallons of radioactive water sat above the waste mineral pile and has drained into the Floridian aquifer system, which supplies drinking water to millions of residents.

The Florida aquifer, one of the highest producing in the world, is the principal source of groundwater for most of the state, and extends into southern Alabama, Georgia and South Carolina. Mosaic said it is monitoring the groundwater and has not found evidence that any off-site water is contaminated

The sinkhole was discovered in late August, after an employee saw water levels dropped in a pile of waste. Mosaic said it did not inform the public of the sinkhole for three weeks after the discovery because it found there was 'no risk'.



Mosaic began diverting the pond water into an alternate holding area to reduce the amount of drainage when the problem was first detected. The company said it has been sucking the contaminated water out of the aquifer and back into the plant 'through onsite production wells'.

The Polk County phosphate plant has continued to run after the discovery of the sinkhole. The pond with the sinkhole is 'now dry,' and once the water that went into the deep hole is recovered, it will be reused in plant operations.

The incident comes less than a year after Mosaic settled a massive federal environmental lawsuit with the US Environmental Protection Agency. EPA found that Mosaic improperly handled its facilities, which posed a threat to the environment and human health. Mosaic agreed to nearly $2 billion in fixes, improvements and cleanups at its plants and publicly committed to becoming more environmentally friendly.

The future of Lots Road Power Station, Chelsea

Most man-made underground spaces have associated with them tell-tale surface features, even if no more than the material excavated to create them. Many semi-subterranean municipal air-raid shelters, for example, now appear as grassy humps (often in school grounds or public parks) where bomb-proofing earth has been piled above them. These are easily spotted, even if original entrances and ventilation fixtures have been filled in or obliterated. Long canal and railway tunnels often have still-visible spoil-extraction shaft tops with associated spoil heaps, and far less often surviving tunnel-surveying observatory towers.

A striking example of an enormous above-ground structure with subterranean associations is the former Lots Road power station in the less smart end of Chelsea in west London. This was for over 90 years the electricity generating station for London's underground railways (including of course their extensive and numerous surface lines and structures).

From 2001 this station has been redundant to the requirements of the Underground, and since 2007 has been the site of decontamination work (asbestos and the like), selective demolition, and internal building works. The site and structure are to have a new future as residential and mixed-use redevelopment. The external walls, steel frame, chimneys and selected internal steelwork are being retained. Comparable developments on this scale are the Bankside and Battersea power stations.

Duncan Hawkins has described the history and building of Lots Road, and the recording and conservation elements of the redevelopment programme.

The station was first proposed in 1897 as the conversion of the underground lines from steam to electrical operation set off, before long greatly stimulated by the notorious American Charles Tyson Yerkes [1837–1905], to whom we owe the genesis of London's unified electrical subsurface railways, and especially the first three deep-level tube lines.

The inauguration in 1900 of the City & South London Railway as the capital's first electrically powered underground (and under-river) line could be said to be the start of the Lots Road saga. Construction of Lots Road commenced in 1902, and power generation in 1906. It closed in 2001 after 96 years in service.

Presumably, as at Bankside, there were substantial sub-surface voids, but if present at Lots Road they are not referred to, and do not feature in the reproduced engineering drawings accompanying the article.

SOURCE: HAWKINS, Duncan, 2016, Converting a colossus: building conversion and conservation at Lots Road power station, Chelsea. *London's Industrial Archaeology* 14, 3–13. (GLIAS)

Man abducted girlfriend and drove her to abandoned ROC bunker

Mark Hildreth, 42, tried to force his partner and the mother of his child into a deserted ROC bunker, late on 31 December 2015. He told her "you are going to die tonight", and punched her repeatedly in the head.

Hildreth picked Ms Bentley up after she had been for

a post-work drink in York city centre at around 9pm. Instead of taking her back to the home they shared in the south of York he drove erratically along the A64 and threw her phone out of the window before stopping on a lane near Stamford Bridge, near the entrance to the bunker, and telling her to climb down the ladder.

Ms Bentley was extremely frightened and tried to run away more than once, falling and banging her head in the mud. Each time Hildreth caught her and took her back, terrifying her with threats including "No one will find you there", "The others didn't like it down there" and "You are going to die tonight".

Stamford Bridge ROC post. Photo Nick Catford

Eventually, Hildreth drove them both back to York, but continued the ordeal punching his partner in the head repeatedly. Eventually they left the house for a pub nearby, and Ms Bentley managed to take his phone to get a message to her mother. Hildreth fled, but the police found his partner in the pub and arrested him soon afterwards.

Sentencing him to four years in prison for abduction and false imprisonment at York Crown Court in August, Judge Deborah Sherwin told him he will have time to reflect on the appalling violence he put his victim through.

SOURCE: *The Press (York),* 16 August 2016

Friends of the Crystal Palace Subway

The Friends of the Crystal Palace Subway (www.cpsubway.org.uk) are 'working with local authorities towards re-establishing public access for such events as Open House'. The subway passes below Crystal Palace Parade (A212) in south London.

Its history was described in *Subterranea* 36 (August 2014). This was no common or garden station subway, familiar to all, but offered a spacious walk between columns and below a ceiling of polychrome brickwork. It was opened to first-class ticket holders arriving by train at the former Crystal Palace High Level station in 1865, giving direct access below the road to the 'Palace', but presumably went out of public use when the 'Palace' was destroyed by fire in 1936.

The station itself was closed in 1954, and in the war years the subway was used as an air-raid shelter. The steps down to the subway can readily be seen from the Palace end in Crystal Palace Park, and are the responsibility of the London Borough of Bromley but are not publicly accessible, other than by arrangement with the Friends.

The entrance at the station end of the subway, on the west side of Crystal Palace Parade, is controlled by the London Borough of Southwark. It is by way of the west entrance that the Friends seek to restore occasional public access.

Forgotten fire station found untouched after 60 years

A secret 60-year-old fire station – complete with firefighting equipment and uniforms – has been discovered in the bowels of a Black Country factory.

Staff at shopfitting company The Alan Nuttall Partnership have carried out a thorough investigation of the hidden fire base which had been tucked away at the large Dudley factory which has been the company's home since 1986, but where many corners have been left unexplored until now.

The room contains perfectly preserved uniforms, with the names of the wearers chalked above them. Scrawled names include I Silk, W Price and A Round.

The pump trailer

Documents suggest the items date back to the early 1950s, when the local Co-op, which had its own fire brigade, operated from the building.

The most impressive piece in there is a pump trailer, powered by a petrol or diesel engine, still bright red, with 'CWS DUDLEY' lettered in gold on the front. There's still air in its tyres and just a few spots of oil on the floor beneath. Hanging on one wall is a row of neatly rolled-up canvas hoses, along with a single gas mask.

The factory was built in 1915 to provide weapons for the Great War, then became the manufacturing hub for Bean Cars. Nuttalls have now asked for help in restoring the pump.

SOURCE: *Birmingham Mail,* 2 October 2016

Disposal of carbon dioxide underground in Iceland

In that Iceland, unlike most European countries, derives a great deal of its energy requirements from hydro-electric power stations and geothermal resources, it can hardly

be said to be a major producer of carbon dioxide per head of the population, and therefore a major cause of climate change.

It is, nevertheless, experimenting with ways of immobilising greenhouse gas, hopefully permanently, underground. In 2012 around 250 tonnes of the gas, mixed with water and hydrogen sulphide, was pumped down a 450-metre deep borehole. Although the chemical reactions involved are less than clear, the idea seems to be that the carbon dioxide and, fortunately, the very toxic hydrogen sulphide are absorbed by calcite and / or the primary mineral constituents of basalt lava. To date, it is reported, 95% has been retained.

SOURCE: ANON, 2016, Calcite storage. *Descent* 252, page 5.

NEWS – PUBLICATIONS

Archaeology of darkness

DETAILS: DOWD, Marion, and Robert HENSEY (edrs), 2016, *The archaeology of darkness*. Oxford: Oxbow Press: xiv + 143pp [ISBN 9781-78570-191-7]

This is a well-referenced collection of 13 essays by various authors. As well as the expected contributions on man-made and man-used underground spaces, there are essays on archaeological aspects of life in the long days and weeks of darkness in inhabited Arctic areas, for example. The scope is the pre-modern periods, with the copper mines at the Great Orme in North Wales one of the most recent developments noted.

No sites of military consequence feature. The main contents concern cave habitations, cave and chambered tomb burials, and prehistoric mining, where any light temporarily present is from lamps burning animal or vegetable fats or oils. Sites in Ireland are especially well represented, and some in mainland Italy and Sardinia.

Prehistoric art underground and at the surface

DETAILS: BAHN, Paul G., 2016, *Images of the Ice Age. 3rd edition.* Oxford University Press: xxiv + 480pp [ISBN 9780-19-968600-1]

The third edition of Paul Bahn's book is international in scope, but especially comprehensive in terms of France and Spain, and with the British Isles well represented. Paintings on cave walls, and incised images such as are more commonly found in the UK, are a major part of the subject matter, but portable artefacts, many of them of bone, bearing incised images are also covered. Alongside surviving stone tools and the like, these ancient images provide an insight into the lifestyles and minds of our ancient ancestors.

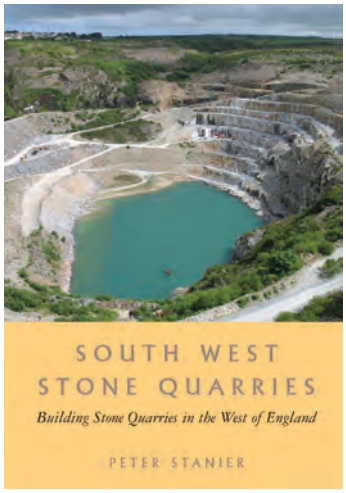
Industrial archaeology of Shropshire

DETAILS: TRINDER, Barrie, 2016, *The industrial archaeology of Shropshire. 2nd edn.* Woonton Almeley: Logaston Press: viii + 296pp [ISBN 9781-910839-05-8] [1st edn was in 1996] [£15]

An updated and completely revised edition of Barrie Trinder's book *The Industrial Archaeology of Shropshire* has been issued; this second edition is fully illustrated, with numerous images in colour. Underground places are naturally well represented, with text relating to tunnelling as well as mining for barytes, coal, fluorspar, ironstone, lead, limestone, metals etc. The work includes a 14-page bibliography, 10 pages of notes, an index of names (six pages), of places (nine pages) and of subjects (three pages) to assist readers seeking more detailed publication.

Building stone quarries of southwest England

DETAILS: STANIER, Peter, 2015, *South West stone quarries: building stone quarries in the west of England*. Truro: Twelveheads Press: 216pp [ISBN 9780-906294-83-3]



Peter Stanier, originally from Liskeard, Cornwall, and now living in Shaftesbury, Dorset, has been researching stone quarries since the 1970s and has numerous publications, books and papers in journals, to his credit from at least as early as 1978. Quarries are understood, for the purposes of this book, in the original sense as places, whether opencast or underground, where dimension stone was extracted for squared blocks for the construction of buildings, monuments, and civil engineering such as bridges and docks.

Quarries in the modern sense, as defined in the 1894 Quarries Act as excavations exclusively open to the sky for any sorts of minerals, are included only if they yielded dimension stone. Pits worked for aggregate, chalk, gravel, roadstone and sand, for example, are not included. The geographical scope includes all or parts of Cornwall, Devon, Dorset, Gloucestershire, Somerset and Wiltshire.

Underground quarries, most of them for limestones, are well-represented. After accessible accounts of the geology of building stones in southwest England, where igneous, sedimentary and metamorphic rocks have all been used in building, the main text draws heavily on three ms. notebooks compiled by the geologist George Frederick Harris [1862–1906] relating to his visits to quarries in 1893–1894.

Many of Harris's sketches in the notebooks, which are held in the archives of the British Geological Survey, have been reproduced and include diagrams of beds worked,

working faces, tools, etc. These, and extracts from Harris's notes, are supplemented by historic photographs from the BGS archives, and also by notes and modern photographs taken by the author in the case of his own visits to disused and still active quarries. A chapter is also devoted largely to the importance of the development of the railways in the distribution of quarried stone, much of which of various kinds was extensively used in nineteenth-century London, and indeed is still used.

Notable quarries for which few details are supplied are those at Beer in Devon. If Harris visited that county, any details he may have recorded are not included in the three notebooks in the BGS archives.

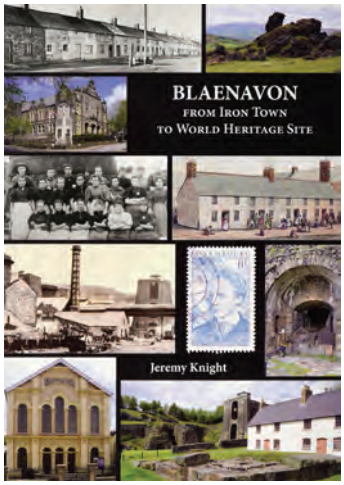
There are especially interesting illustrated accounts – of particular interest to Subterranea Britannica members – of historic and in some cases modern subterranean quarrying at Box, Corsham and Chilmark, Wiltshire, before and after occupation by the Royal Air Force for munitions storage. The entirely modern new subterranean quarry on the Isle of Portland, known as Jordans Mine, is described and illustrated.

This book is exceptionally well researched, written and illustrated, and contains helpful supplementary notes to each chapter, three pages of bibliographical details of sources consulted, and a four-page index. It is highly recommended.

Blaenavon World Heritage Site, south Wales

DETAILS: KNIGHT, Jeremy, 2016, *Blaenavon: from iron town to World Heritage Site*. Woonton Almeley: Logaston Press: xvi + 192pp [ISBN 9781-910839-01-0]

Seven square miles of and around Blaenavon, between



Abergavenny and Ebbw Vale in south Wales, was made a World Heritage Site in 1999 on the grounds that this is 'an outstanding and remarkably complete example of a 19th-century industrial landscape' with the remains of coal and ironstone mines, limestone 'quarries', blast furnaces and their associated town, dating from the time when South Wales was counted the world's largest producer of iron and steel.

Apart from surviving buildings and structures, there are to be found here the 'Big Pit' colliery which closed in 1980 but was reopened as a museum with an underground visitor option in 1983, and the Pwll Du tunnel, described as, at two kilometres, the longest tramroad tunnel ever built, in 1816–17. The tunnel was part of one Thomas Hills' 5.5 km. tramway made to convey limestone from the far side of a hill to works closer to the town. It incorporated, in part, a pre-existing coal mine level.

When the limestone pit was disused after 1920 the tunnel went out of use, as did two shorter cut-and-cover bores, the Blorenge and Garnddyrys tunnels. At least one portal of the Pwll Du tunnel has been restored, and illustrated in this volume. There were standard-gauge rail connections from Newport and Pontypool for goods and passengers at various dates between 1954 and 1962.

Blaenavon is clearly an important location not yet visited by Subterranea Britannica, and especially worthwhile as here the mineral extraction sites can be seen side by side with the furnaces and forges where the minerals were used. Although this volume is light on geological and subterranean detail, it does have a useful 'timeline' of principal and national events, a bibliography, general and personal name indexes, and a colour reproduction from an approximately 1880 Ordnance Survey map.

Neolithic flint mines World Heritage Site at Spiennes, Belgium

DETAILS: COLLIN, Jean-Philippe, 2016, *The Neolithic flint mines of Spiennes: history of a World Heritage Site.* Mons: City of Mons: 88pp [ISBN 2000-00001-682-5]

Subterranea Britannica members who visited Belgium and the Netherlands during study weekends in recent years will doubtless remember the archaeological excavations at Spiennes, a little to the south of Mons (the city also known in the Flemish-speaking part of Belgium as Bergen). On that occasion we were able to descend a shaft into one of the numerous prehistoric flint mines at this locality and observe archaeologists at work underground.

This site, designated by UNESCO as a World Heritage Site, now has an impressive new visitor centre within which members of the public have the opportunity to go to depths up to 16 metres underground to see the mines, which have been the subjects of archaeological research since their discovery in 1855.

This exceptionally well-presented English language guide book is in your scribe's opinion amongst the best of its kind. The chalk geology and its contained layers of flint are described in accessible terms, with coloured sectional diagrams showing how the mined voids relate to the chalk and superficial strata.

Reference is made to similar mines at Grimes Graves (Norfolk) dated to 2,600 to 1,900 BC, and others in mainland Europe but not, oddly, to those at Rijckholt–St Geertruid in the southern Netherlands. Colour illustrations depict the mine interiors, and artefacts including mining tools and manufactured artefacts such as stone axes found at the site.

Underground archaeology in Umbria, Italy

DETAILS: MELELLI, Alberto, and Luca Domenico VENANTI (edrs), 2007, *Umbria sotteranea / underground. Archeologia e idraulica urbana / archaeology and urban hydraulics.* Perugia : Quattroemme SRL: 232pp [ISBN 97888-89398-23-4]

This splendidly illustrated hardback volume is no dry academic tome, but an overview of man-made underground spaces, many of them publicly visitable, in Umbria, an inland region somewhat to the north of Rome. In part, at least, this is an area of volcanic rock, and straddles the Appenines.

The sites described are at or near such places as Orvieto and Narni in the south of the region, northwards to Perugia and Gubbio. A map shows the locations of 23 places of underground interest, including nine which are publicly visitable. As the title indicates, these sites are mainly rock-cut excavations made at various dates from the Roman era onwards for water supply, including aqueducts, cisterns and reservoirs, as well as catacombs, quarries and tunnels. The text is in both English and Italian, and there are numerous surface and underground photographs (many in colour), plans and sections.

Thanks go to member Joep Orbons, who visited Umbria this year, and generously sent your scribe a copy of the volume, and leaflets containing details of publicly visitable underground sites at Orvieto and Narni.

Sub Brit has formally visited Italy only once so far, to Rome earlier this year, although your scribe represented the society at a conference at Naples some time ago. Joep suggests the Umbria region might well be considered for a future study weekend.

NEWS – TUNNELS AND TUNNELLING

World's longest road tunnel could be built under the Pennines

The world's longest road tunnel is set to be built in Britain in a bid to slash driving times between cities. A vast tunnel under the Pennines, which could stretch 18 miles, will link Sheffield and Manchester.

Proposals for a new multibillion-pound project were first published last year as the Government responded to criticisms of current links. Five possible routes, set to cut journey time between the two cities from 85 to 65 minutes, have now been shortlisted. Each would involve a tunnel at least ten miles long, with the longest possibility being 18 miles. This would make this road tunnel the world's longest, beating Norway's 15-mile Lærdal tunnel.

The government has acknowledged the dangers of tunnels of this length, with one study noting possible ''claustrophobia, disorientation and tiredness'' of drivers. It recommended using mood lighting and changing the shape of the walls to keep motorists from getting dizzy, just like the Lærdal tunnel and China's eleven-mile-long Zhongnanshan tunnel.

Mood lighting and laybys inside Norway's LærdalTunnel. Photo Kristinn Einarsson

All of the routes link the M60 Manchester ring road to the M1 north of Sheffield and involve digging two 15m-wide holes through the Peak District. Four of them would utilise the M67, dubbed the 'motorway to nowhere' as it runs for just five miles from the M60 before giving way to the single carriageways of the windswept and winding Woodhead and Snake passes.

Calls for a new road between Manchester and Sheffield have been made for decades but the Peak District National Park has provided the main obstacle, with no one willing to drive a six-carriageway motorway through the moors. A tunnel has been seen as the only realistic way of spanning the highest ground and linking the two cities, which are only 35 miles apart as the crow flies.

SOURCE: *MailOnline*, 19 August 2016

New use for Harrods' service tunnel, London

Harrods' department store has long had a service tunnel from the basement to storage space and staff accommodation nearby. There is now a plan to change the use of this passageway to allow suitably wealthy customers to go shopping from their retirement homes in a planned seven-storey building without having to take to the streets and encounter London rain and London traffic.

The Harrods service tunnel under construction

For accommodation in the retirement home residents will have to be aged 55 or older, not to mention sufficiently well-off to afford one of 34 apartments at at least £5m each. Amongst other features will be parking space

for eight mobility scooters. Ideal for older members of Subterranea Britannica.

SOURCE: PRYNN, Jonathan, 2016, Retirement home that has a tunnel link to Harrods. *Evening Standard*, 5 August 2016

Disused railway tunnel designated as Historical Engineering Work

A disused railway tunnel in Queensbury, West Yorkshire, which a campaign group wants to reopen as a cycle path, has been designated as a Historical Engineering Work by the Institution of Civil Engineers.

Queensbury Tunnel, which was engineered by Leeds-based John Fraser for the Great Northern Railway in the 1870s, has been earmarked for a cycleway – although a row over costs has been rumbling on.

Norah McWilliam, leader of the group campaigning to save the tunnel, said: "We are delighted to hear that the panel for Historical Engineering Works recognises the tunnel's importance as a fabulous feat of engineering, even if the Historical Railways Estate is determined to put it beyond reuse. We ought to value this tunnel – and others like it – because of the role it could play in encouraging people to adopt more sustainable forms of transport."

The first freight train passed through the tunnel in October 1878 – more than four years after construction started. When the contractors finished work on it, the tunnel was the second longest on the GNR network at 2,541 yards.

The southern entrance to the Queensbury tunnel during construction

Peter Harris, tunnels convenor on the panel for Historical Engineering Works, said: "Queensbury Tunnel is a regionally significant structure because of its history, scale and construction. It was one of the first railway tunnels to benefit from the use of a rock-drilling machine which helped the miners to drive a section of heading at a rate probably four times faster than using hand drills.

In the 1930s, one of the shafts had a series of unusual reinforced concrete frames inserted to help support a secondary lining. Then, after closure, the tunnel was used as a seismological station. Cambridge University installed strain meters in the central part of the tunnel and the scientists monitoring them had to sleep overnight in a hut.

SOURCE: *Bradford Telegraph & Argus*, 24 October 2016

Rock-cut 'caves' and the Park Tunnel, Nottingham

A report of a Geologists' Association field meeting at Nottingham notes that those attending were afforded a close inspection of the Sherwood Sandstone exposed in the walls of several of the rock-cut 'caves' under the city, and of the spectacular Park Tunnel.

The tunnel, one of the earliest road tunnels in the British Isles, was opened to road traffic in or about 1850, with unrestricted public access as the way through it is now a public footpath. It is a spacious bore through unlined sandstone, and has a light well and public access steps part-way through, as well as via both portals.

The cited source includes a full-page colour photograph taken at the light well. The only surviving earlier road tunnels are at Tunnel Road, Reigate; two on turnpike roads in Dorset; and one in southwestern Ireland. The road tunnel commenced at Highgate, north London, collapsed before completion and was opened out as the Highgate Archway cutting.

SOURCE: WALTHAM, Tony, and Steve PARRY, 2016, Field meeting report: Nottingham … *Geologists' Association Magazine* 15(3), 17–20 [Includes a large colour photograph of the Park Tunnel]

Floating underwater tunnel in Norway could cut a 21hr journey in half

Norway is known for having some of the most scenic routes in the world. Along the E39 in particular, which traces the western coast of the country from Kristiansand to Trondheim, you'll find some breathtaking views of Norway's famous fjords. But while the view is spectacular, the drive is currently a painfully long 21 hours – all thanks to seven different ferry crossings.

That could all change if a series of submerged floating tunnels currently being proposed becomes reality. The proposed tunnel will be composed of two 4,000ft-long concrete tubes, one for each direction that will be braced to each other using trusses and to the bedrock. Each tube will have room for two lanes – one for travel and one for emergencies and repair work. The vertical position of the tubes will be controlled by a series of pontoons that will be floated on the surface of the fjord. These pontoons will be spaced apart wide enough for ships to pass through.

An artists impression of the floating tunnel

The tunnels will be designed to withstand any tidal movements as well as the effects of ice and cold weather.

And as they are below the surface, weather phenomenon such as wind and waves shouldn't affect them either. The underwater crossings are set to be installed under several fjords along the coastline and will cost a staggering £19 billion.

At present, landings on either side of the fjords are connected by ferries as the distance is too wide and the waters too deep for normal bridges.

A feasibility study conducted in 2012 by the Norwegian Public Roads Administration (NPRA) revealed that the floating tunnels could be the best way to bridge the fjords.

The first of these tunnels is being proposed for Sognefjord, and will connect Oppedal and Lavik. Sognefjord is currently being served by a 20-minute ferry ride between the two villages.

SOURCE: *MailOnline,* 24 July 2016

Nordic countries' longest railway tunnel commenced, Norway

Dignitaries were assembled in a 'mountain cavern' at Åsland in Norway to witness the launch of two of four tunnel-boring machines installed to drive the first excavation work in the 20-km twin tunnels on the Follo line from Oslo to Ski. The four TBMs will each bore about nine kilometres of tunnel.

Each German-manufactured machine is 150 metres long and weighs around 1,000 tons, and (as with Crossrail) is named after more or less famous ladies of the country. The first two to commence work are tunnelling towards Oslo. Tunnelling is expected to be completed by the end of 2017. The journey time from Ski to the capital is expected to be halved, using the new tunnel with trains running at up to 250 km per hour when traffic commences in 2021.

SOURCE; ANON, 2016, Norway: Follo line TBMs launched. *Modern Railways* 73(818), page 82.

Drug smugglers' underground railway on the Mexico / USA border

US agents have found a cross-border tunnel equipped with a narrow-gauge rail line made to facilitate the smuggling of drugs from Mexico into California. Reportedly, tonnes of drugs such as cocaine and marijuana were being transported to an exit hidden under rubbish bins in open ground on the American side.

The metre-wide 800-metre tunnel commenced under a house in Tijuana, and ran to a point below a wooden pallet business in San Diego, and was equipped with lighting and ventilation systems. Over a tonne of cocaine and seven tonnes of marijuana were seized.

This was the thirteenth under-border smuggling tunnel detected since 2006. Three had their exits under properties in the same street in San Diego, running parallel with a densely populated area in Mexico.

SOURCE: ASSOCIATED PRESS, 2016, Down a rabbit hole: underground rail used to smuggle to US, *The Guardian*, 22 April 2016, page 27.

A TBM novelty, Singapore

A novel tunnel-boring machine which drives a rectangular-section tunnel, made in China, is to be used to excavate a 60-metres underpass for a 43 km new commuter rail line in Singapore. Described as a box-jack rectangular TBM, it is somewhat reminiscent of Mark Brunel's Thames Tunnel shield!

SOURCE: *New Civil Engineer,* February 2016, page 9.

Spring Meeting 2017

Saturday 22 April, commencing at 10.25am,

Royal School of Mines, London, SW7 2BP

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There will be the usual mix of interesting illustrated talks along with Members' contributions and a chance to meet and mingle with fellow enthusiasts. Speakers confirmed so far:

* Mike Barton on the bunker at Wunsdorf/Wudo, Germany

* Andrew Smith on South East Asian Bunkers.

Booking will be either via the website at www.subbrit.org.uk/events or by post to our registered address.

Non-members are very welcome to attend.

Cost £20 to include a sandwich lunch.

Please put the date in your 2017 diary now!

Subterranea Britannica : Study Weekend Copenhagen 12 - 15 May 2017

We're pleased to say that one of our Sub Brit members, Lars Hansson, who lives in Sweden, has agreed to work with us to set up a weekend of visits in Copenhagen, Denmark.

Sites that we are planning to visit include (the list is not guaranteed and may change)

- **Copenhagen Castle and City Fortifications**
- **New Metro**
- **Nike/Hawk batteries**
- **Stevens Fort, Cold War coastal artillery**
- **Cold War central bunker 'Ejbybunkern' in the Western defences wall**
- **Civil defence command central**
- **Bridge and Tunnel crossing to Malmo by road and rail.**

You will need to make your own travel arrangements to/from Copenhagen; we will be looking to book a hotel for the group near the centre, probably close to a station. Travel during the weekend and meals will be arranged. As it's Denmark, the costs will probably be quite high – estimate around £350 in a shared room – to include 3 nights hotel, meals, transport and admissions.

This year we will again be taking bookings online

All attendees must be members of Sub Brit for insurance purposes.
Ensure you renew your membership for 2017 promptly.

You must be 18 or over to attend, or be accompanied by a parent/guardian.
If you do not have access to the internet, then please send a letter expressing your interest to our registered address.

The trip will be advertised by email to members

This will happen once we have got more details and firmed up on dates and times, hopefully during January.

- Log on to 'mySUBBRIT' at https://mysubbrit.org.uk & click on 'Register for event'.

When you book you will be asked for the following:

- type of hotel room (single, double or shared). Note that if you want any extra nights in the hotel you should book these yourself;
- any food preferences (vegetarian, gluten-free etc.);
- to pay a deposit of £50, preferably by PayPal. Full payment will be requested six weeks before the trip, this will be by cheque or bank transfer (to avoid excessive Paypal charges).

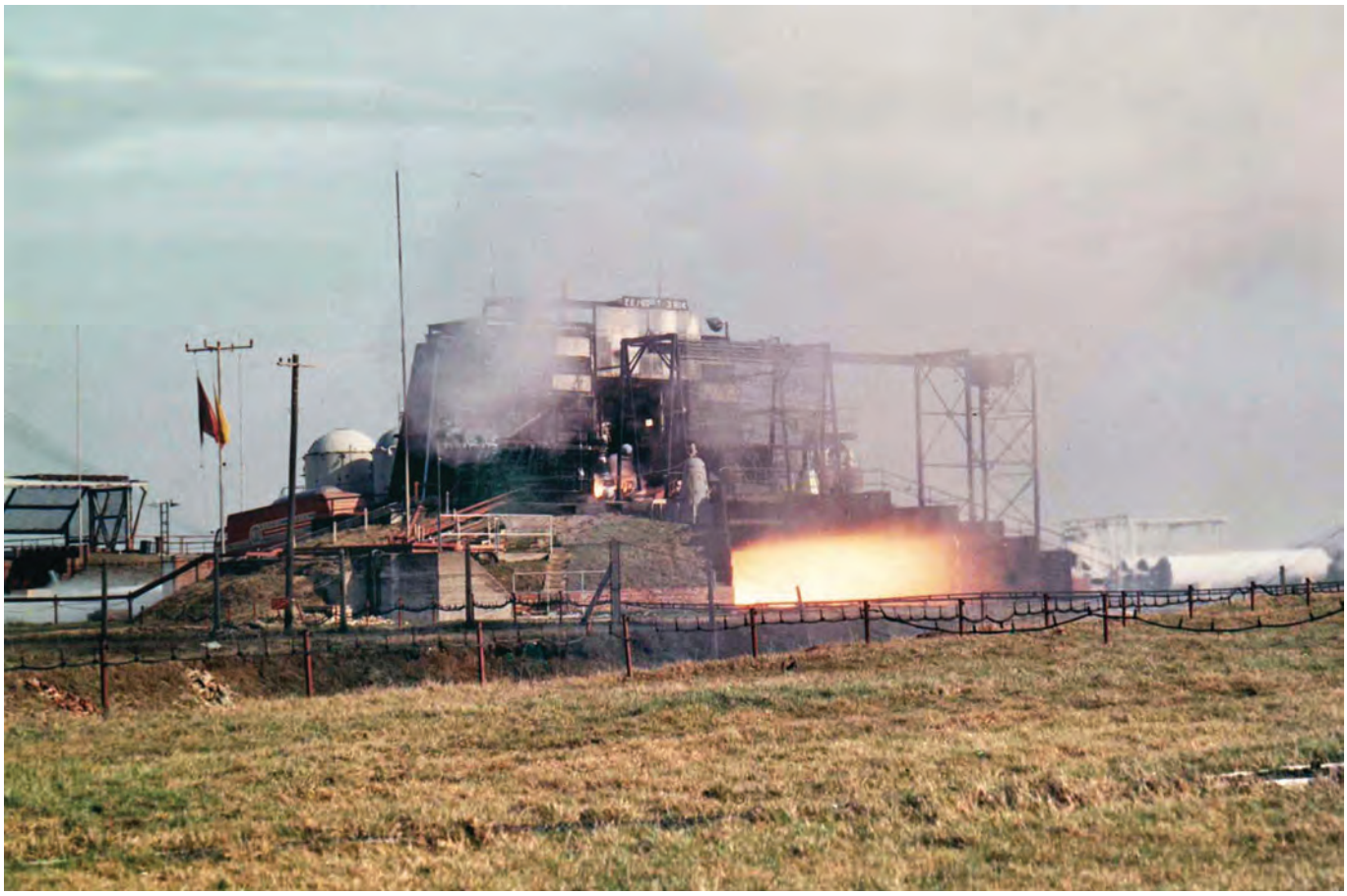
Acknowledgement of your booking will be by email. Full joining instructions will be sent just before the trip.

Keep up to date with Sub Brit Events by choosing to receive emails from the Sub Brit Forum – see Issue 39, page 24 of ***Subterranea*** for how to do this.

The Oresund bridge (and tunnel entrance) between Copenhagen, Denmark and Malmo, Sweden

Westcott Rocket Propulsion Establishment, Buckinghamshire

Nick Catford



P1 site firing. Photo from Ed Andrews collection

RAF Westcott opens

RAF Westcott opened in September 1942; it was located close to the village of Westcott, in the Aylesbury Vale District of Buckinghamshire, eight miles northwest of Aylesbury. It was a training airfield and home to No. 11 Operational Training Unit (OTU) who began transferring there from their previous base at Basingbourn in October 1942.

Westcott, together with its satellite station RAF Oakley, had older and newer versions of the Vickers Wellington bomber together with a selection of other types of aircraft. The OTU's function was to form bomber crews and to train them not only to work as a team, but with the skill and proficiency to ultimately allow operational deployment. As part of this training, they were involved in leaflet dropping over enemy territory. Many of the crews trained at Westcott later saw active service in Lancaster bombers in the prolonged aerial offensive undertaken by Bomber Command over occupied Europe.

The airfield was provided with three concrete runways, one B1 and four T2 hangars and a model 12779/41 watch office. This was the standard watch office (control tower) designed for use at all training airfields; it was later adopted in 1943 as the standard for all commands. Shortly before the end of the war in Europe in May 1945, No. 11 Operational Training Unit's final role was the repatriation of former Allied prisoners of war.

Operation Exodus

Westcott airfield in April 1947

Operation Exodus began on 2 April 1945 and by its completion on 3 June, 75,000 personnel had been airlifted back from Europe with 35,000 of them arriving at the clearing centres established at Westcott and Oakley. On 5 May 2010 the Battle of Britain Memorial Flight overflew Westcott in recognition of the 65th anniversary of *Operation Exodus*.

11 OTU was disbanded on 18 September 1945 and the airfield was placed under Care and Maintenance until RAF Westcott closed on 3 April 1946. From that date the airfield was handed over to the Ministry of Supply. Although flying ceased then, the airfield still retains an NDB (Non-Directional Beacon) which broadcasts the identity WCO (.--/-.-./---) on 335 KHz.

A new use for the airfield

The postwar programme of work on rocket propulsion was initiated when the Ministry of Supply undertook the responsibility for investigating German research on unconventional methods of propulsion. Westcott was chosen after a wide search, being fairly central and accessible from other establishments involved with related research. Being a former RAF station, the new Guided Projectile Establishment (GPE) was able to make use of four large hangars and two other blocks of buildings while new buildings, including laboratories and test stands, were constructed.

Until 1948, a team of seventeen German scientists designated as 'special internees' were moved to Westcott to continue their research into liquid propellants alongside their British counterparts. Examples of German weapons which were kept at Westcott for research included the V-1 flying bomb ('doodlebug'); V-2 rocket; Feuerlilie F-55 subsonic missile; Messerschmitt Me-163B rocket-propelled interceptor; Rheintochter-1 anti-aircraft missile; Ruhrstahl X-4 air-to-air wire-controlled missile; Enzian 3,150-lb missile; Henschel Hs 298 anti-aircraft missile; Hs 293 anti-shipping weapon; and Schmetterling and Wasserfall anti-aircraft missiles. Quite some firepower!

Captured German hardware brought to Westcott

An early rocket test stand 'The Lizzie Hut' at Westcott in August 1947

The German scientists were headed by Dr Johannes Schmidt, who was largely responsible for the development of the Walter rocket which powered the Me 163 interceptor. Also at Westcott was Walter Reidel who had worked with Wernher von Braun on development of the V2 rocket at Kummersdorf and later at Peenemünde. The German scientists were given twelve-month contracts and were housed in Nissen huts off the site. They had a free hand to work on their own special subjects but were not permitted access to information on other developments at Westcott. The last full-time German scientist retired from Westcott as late as March 1977.

Remains of the liquid engine firing site at Kummersdorf where Wernher Von Braun did his Army sponsored degree research

Explosive Mixture

Initially, Westcott served the Army and Navy, while the Royal Aircraft Establishment (RAE) at Farnborough was responsible for rocket research initiated by the Air Ministry. The RAE coordinated research, with all types of rocket propulsion being developed at Westcott. New rocket motors were built and tested there with flight trials being conducted mainly at Aberporth in West Wales or at Shoeburyness. It was intended that large rocket missiles would be proved on the range under construction at Woomera in Australia.

On 14 November 1947 Dr Schmidt and three others were killed when a German Walter 109-510, a liquid-fuel bipropellant rocket engine that powered the Messerschmitt Me 163 and Bachem Ba 349 aircraft, exploded at 'D Site'. Westcott generally had a very good safety record with only two other fatalities and one of those was a motorbike accident on the runway.

'D site' after the explosion on 14 November 1947

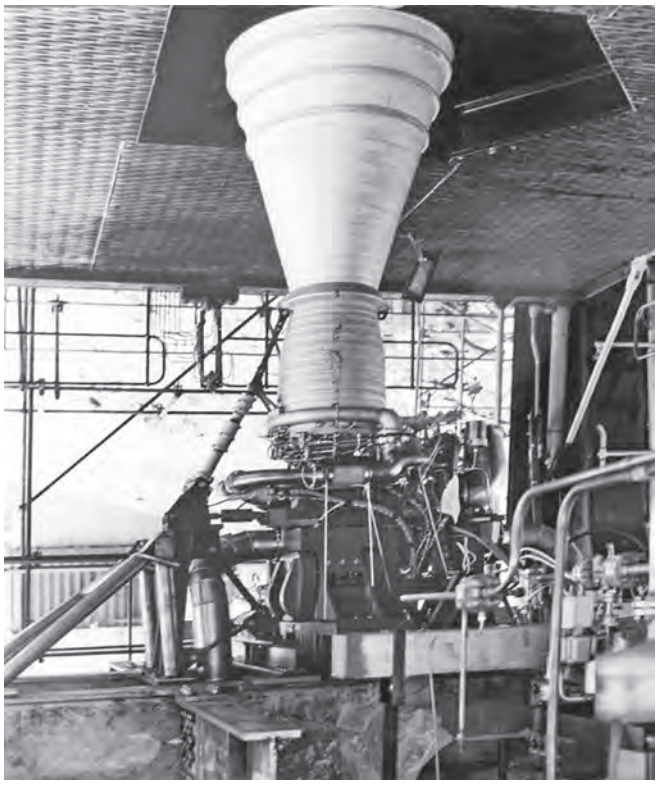
At first, research was focused on liquid bipropellant systems (those in which an oxidiser and fuel are tanked separately and mixed in the combustion chamber) for rocket engines with research into solid propellants starting in 1949. By this time, the facility had been renamed the Rocket Propulsion Department of the Royal Aircraft Establishment.

Throughout the 1940s, the research into liquid propellants at Westcott was carried out alongside the Waltham Abbey experimental station. However in the early 1950s all such work was concentrated at Westcott as it was a large secluded site where a number of specially built facilities were ideal for the testing and evaluation of new rockets which would be fired but never launched. Between 1946 and the mid-1990s Westcott was responsible for the designing and testing of most of the rocket motors used in British guided missiles. The design of the complete missile systems was undertaken by the Royal Aircraft Establishment at its facilities in Farnborough and Bedford.

Blue Streak and other missiles

One of Westcott's successes was Skylark which was a 'research rocket' (or 'sounding rocket'), an instrument-carrying rocket designed to take measurements and perform scientific experiments during its sub-orbital flight. The Skylark was first launched in 1957 from Woomera and its 441st and final launch took place from Esrange Space Center in Sweden on 2 May 2005. The design first dates from 1955, when initial work was carried out by the Royal Aircraft Establishment at Farnborough and the Rocket Propulsion Establishment at Westcott.

In the late 1950s, the liquid propellant motor for the Blue Streak missile (the RZ2) was developed at Westcott and went on to be used in the Europa-1 space rocket launch vehicle. The Blue Streak project was intended to maintain an independent British nuclear deterrent, replacing the V-bomber fleet which would become obsolete by 1965. Although design was complete by 1957 it became clear that the missile system was too expensive and too vulnerable to a pre-emptive strike and the project was cancelled in 1960.



The RZ1 engine for Blue Streak under test at 'P' site

Other rocket and missile programmes in which Westcott had a part to play included the first-, second- and third-stage motors for the Jaguar (or Jabiru), another 'research rocket'. The complete rocket was 12 metres long; in all stages solid fuel was used. The Jabiru Mk.1 was launched several times between 1960 and 1964 at Woomera. The upgraded Jabiru Mk.3 was used for re-entry experiments between 1971 and 1974.

In the 1960s the Waxwing third-stage motor for Black Arrow was tested at Westcott. This was a satellite carrier rocket that was used for four launches between 1969 and 1971. Its final flight was the first and only successful orbital launch to be conducted by the UK, placing the Prospero satellite into low Earth orbit.

The Torrey Canyon *test rig in action in 1970*

Westcott was also involved with small missile projects like Blowpipe and Seawolf and in the development of the Polaris nuclear weapons system in the 1960s and Chevaline in the early 1970s. Chevaline was a project to improve the penetrability of the Polaris warheads and was devised as an answer to the improved Soviet anti-ballistic missile defences around Moscow.

On 1 June 1958 Westcott was renamed Rocket Propulsion Establishment (RPE) and was now totally independent from RAE Farnborough. In June 1959 the Ministry of Aviation assumed responsibility for the facility and in April 1966 this was transferred to the Ministry of Technology and in June 1970 to the Ministry of Aviation Supply. Following the *Torrey Canyon* oil tanker disaster on 18 March 1967, Westcott was used to test-burn crude oil in an attempt to find a method for its dispersal. A tank simulator was constructed in July 1970; it was then fired up in an attempt to understand how effectively the oil burnt.

Moving into the private sector

In May 1971 responsibility for Westcott was yet again transferred, this time to the Ministry of Defence. On 1 April 1973 Westcott was merged with the research facility at Waltham Abbey to become Rocket Propulsion Establishment/Explosives Research & Development Establishment (PRE/ERDE) and on 23 February 1977 PRE/ERDE combined to become Propellants, Explosives and Rocket Motor Establishment (PERME). On 1 April 1984 Westcott came under the control of the Royal Ordnance Factories. On 31 December 1984 the Ministry of Defence gave up jurisdiction for Westcott which then passed into the private sector; on 1 April 1987 British Aerospace acquired Royal Ordnance.

Throughout these times of changing ownership and jurisdiction Westcott remained in the front line of research and development of liquid propellant rocket motors with the LEROS liquid engine. LEROS is a family of chemical rocket engines initially developed by Royal Ordnance but now manufactured at Westcott by Moog-ISP, a division of the American parent company Moog Inc.

LEROS engines have been used as primary engines for telecommunications satellites such as the Lockheed Martin A2100 as well as deep space missions such as *Juno* and the European Space Agency's *Rosetta* probe. LEROS engines have also been used on a number of NASA and other space agency missions including the Mars missions of the late 1990s. On 1 January 1992 Royal Ordnance was absorbed into BAe Dynamics.

The first unit of the newly formed Westcott Venture Park was let on 1 July 1995. On 27 August 1999 British Aerospace sold the Westcott Venture Park to Rutland Business Enterprises. The 650-acre site is now owned by the Rockspring Hanover Property Unit Trust; it is a business park for general light industry with 75 business

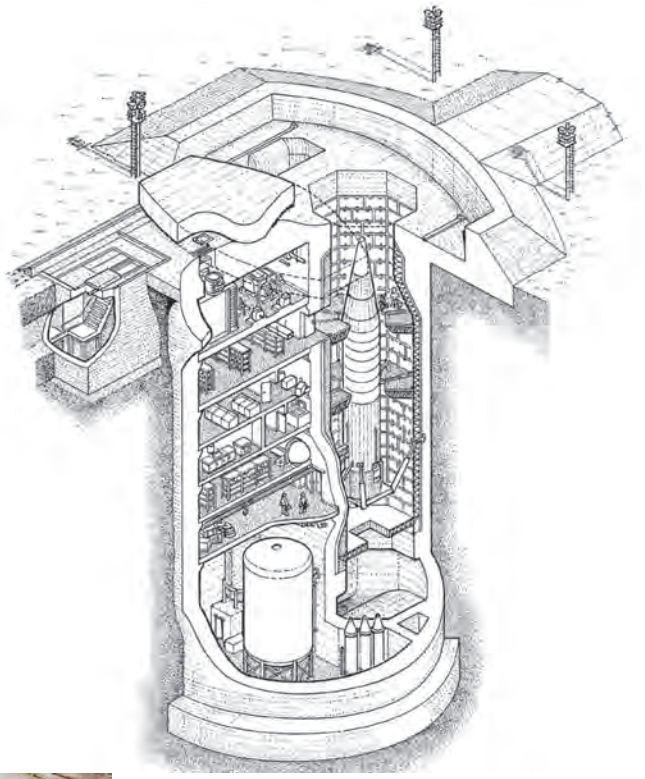
The sites visited by Sub Brit are highlighted in bolder text

tenants including a number of propulsion specialists including Airborne Engineering, European strotech, Moog ISP UK, The Falcon Project and SSTL. Many of the original buildings have been demolished while others have been put to new uses. In May 2013, English Heritage designated five of the surviving test-stands and control rooms as Grade II* or Grade II.

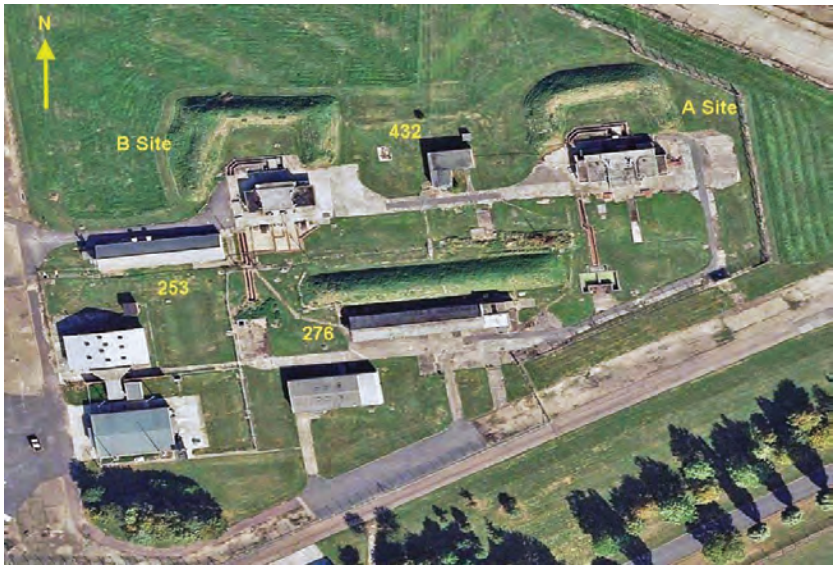
Sub Brit visit to Westcott

Sub Brit member Chris Kenny arranged a visit to Westcott on Saturday 21 November 2015 for 29 members. We met in the visitors' car park and proceeded into reception where we were greeted by our guide Ed Andrews. Ed has worked at Westcott since September 1963 when he was employed as an engineer; he is now the park's managing agent. Ed gave us a brief history of the Westcott site and explained what we were going to see during the day.

Having crammed everyone into as few cars as possible we proceeded in convoy to 'A' and 'B' sites. Together with sites 'C' and 'D' a short distance to the northwest, sites 'A' and 'B' are the oldest surviving tests stands at Westcott. They have, of course, been modified and adapted over the years but the basic structure remains as built in 1947.



The Blue Streak underground launch silo based on architects drawings



A site firing. Photo from Ed Andrews collection

The site, which is enclosed by a security fence, comprises 'A' and 'B' test stands. The buildings are of reinforced concrete and each has an earth traverse on the north side facing the twin firing bays. There are brick-lined drainage channels and settling tanks on the north and south sides of each building. These channels were to drain any surplus chemicals (often nitric acid and hydrazine) away after motor testing, allowing them to be treated before being discharged into the drains. Between the two test stands there is an 'L' shaped building (432); this is a support workshop which housed instrumentation for the test stands.

Blue Streak Silo

The main workshop for the site (Building 276) is to the south of the two stands; unusually this is also protected by an earth traverse on its north side. The prefabricated building is contemporary with the test stands. In the 1960s it was used for the development and testing of a $^{1}/_{6}$th-scale model silo for the Blue Streak rocket.

Another prefabricated building (253) stands to the southwest of Stand A; this was a support workshop. There are other ancillary buildings on the site which are of later construction. The two stands (together with C and D) were often

referred to as the 'German Emplacements' as both sites were associated with German engineers working at Westcott.

Each of the two test stands had two adjacent firing bays, each with its own control / observation room. The stands were designed for the horizontal testing of liquid-fired motors using kerosene and hydrogen peroxide. There are no records of early uses of 'A' stand but tests on the Beta rocket motor for the Vickers Transonic Research Rocket began at 'B' stand in 1947. The stand remained in continuous use until the mid-1980s. One of its last functions was the development of the manoeuvring motors for the Chevaline missile warhead and the stand was left as fitted out for this work. 'A' stand was also used in connection with Chevaline in the mid-late 1970s.

'A' Site

'B' Site. Note the brick-lined drainage channels in the foreground which were used to drain any surplus chemicals after motor testing

The high-security fencing we saw dates from this time; although the whole of the Westcott site was secure, additional security was required for Chevaline. The project was highly secret, and its existence was not disclosed by four successive governments until 1980. Having walked round the site with Ed Andrews – who has a wealth of historical information – we were then able to explore and photograph the buildings at our own pace.

The 'A' site test stand has clearly had some recent use and internally was clean and tidy and still retained its ceiling gantry for lifting motors into position. The 'B' stand was in a derelict state with a number of papers lying on the floor including its Explosives Factory Licence.

The lifting gantry still in place in 'A' site

The Watch Office

The next site we visited was the airfield's two-storey watch office. This was built to the designs of the Air Ministry's Directorate of Works and Buildings, as 'Office for All Commands' design, to Drawing No. 12779/41. On the ground floor there is the watch office itself; duty pilot's rest room; meteorological office; switch room, with lavatories to the rear. The first floor comprises the control room at the front, with the controller's rest room and a signals office to rear which opens onto a passage with access to stairs. External stairs are to one side leading to a balcony around the outside of the control room and another flight of steps up to the roof.

The watch office

The building has been reclad at some time. Although the building had no major role to play in the postwar use of the airfield, it was used as a safety office for some years

View across the airfield from the control room. 'P' site can just be made out in the distance

and later as a store. Internally it is in a derelict state but structurally is still in good condition with most of its windows intact. We were able to climb the stairs onto the balcony but we were asked not to climb up to the roof as the second set of stairs was not in good condition and is considered unsafe.

Special K

We moved off in convoy, our next destination being 'K' site on the west side of the airfield. 'K' site comprises two test stands K1 and K2, K1 being a vertical stand whilst K2 is horizontal. The test stand numbering is somewhat confusing as K2 is the earlier stand. Many of the UK's solid-fuelled rockets and missiles had their components tested at these stands. Both stands remained in use until at least the mid-1990s; K2 was in continual use while K1 was only used intermittently.

K2 was completed by June 1960 and is a horizontal stand for testing large solid fuel rocket motors. The stand is the largest at Westcott and is in three parts comprising a rectangular reinforced concrete test bay with two blast

walls to the southeast. The first towering blast wall is approximately 12 metres high and battered at the rear. There is a rectangular aperture in the centre of the wall to allow the exhaust plume from the test to pass through to the second lower blast wall which is angled to catch any residue of the plume.

K 2 stand used to test horizontal rocket motors

K2 firing. Photo from Ed Andrews collection

The roof of the test bay comprises closely spaced metal rails; an external stairway and a ladder gives access to the roof. The bay has three high-speed camera observation positions in the side walls each consisting of a camera bay accessed by an external door and a metal-framed aperture looking into the test bay. At the far end of the test bay a staircase leads to an elevated camera bay with three further camera positions. There is a sprinkler system mounted high on the walls around the bay.

K2 has two ancillary buildings that were shared with K1. Building 397 is the control room for both sites and next to it is building 428 which is a workshop and store. Neither of these buildings was open so they could only be viewed externally. All three

Internal view of K2. Note the high-speed camera positions in the side walls and the three elevated camera positions at the rear

The first blast wall at K2 is 12 metres high. There is a rectangular aperture in the centre of the wall to allow the exhaust plume from the test to pass through to the second lower blast wall

Wide view of K2 and its two blast walls

buildings are located just off the southwest to northeast runway close to its west end.

K1 was built around 1968; it is located on the runway 45 metres to the south of building 428. This is a vertical stand with solid fuel rocket motors being fired in an inverted position to allow thrust to be measured. The roughly rectangular tower which tapers towards the top is built of reinforced concrete. It has a metal platform with safety rails projecting from the northeast side of the flat roof which is accessed by an external metal stairway on the southeast side. The main entrance is through a projecting porch on the southeast side which leads to a heavy steel door.

Once inside the building, there are rails set into the floor to ease the movement of rocket motors into the testing chamber. There is also a gantry suspended from a recess in the roof with chains and pulleys. The roof itself has a thick metal plate and the walls of the firing bay are reinforced with armour plating. At the back of the chamber there are platforms reached by a ladder to allow access to the motor being tested. There is a second personnel entrance to the north, again protected by a porch.

K1 stand used to test vertical rocket motors

Internal view of K1. Chains and pulleys are still suspended from a gantry on the ceiling to assist in the manoeuvring of the rocket motor. At the back a ladder gives access to platforms to allow access to the motor being tested

We had a free hand to explore both buildings with the external stairs up to the roof and the internal ladder up to the platforms of K1 both considered safe.

The 'P' sites

We then moved on to 'P' site which comprises two adjacent liquid-propellant vertical test stands and ancillary structures built in 1949 with later alterations and additions. The site is located to the south of the perimeter track and west of the north end of the north–south runway. P1 is to the east and P2 to the west.

Together with sites A–B and C–D these are the only surviving 1940s test stands from the early days of rocket development anywhere in the UK. They are the largest liquid-propellant test stands at Westcott. P1 remains in its original condition although it was partially backfilled in the mid-1990s. P2 has been modified several times to accommodate the rockets being tested at that time. Whereas stands A–D could only accommodate engines, the 'P' stands could accommodate complete missiles which were lifted onto the stand by crane.

Although the P1 firing bay has been backfilled the semi-underground control room is still accessible with much of its control and recording equipment still in situ

P1 was built for the research test vehicle RTV2 and would have held the complete missile. It comprises an open-roofed firing bay (now backfilled) shored by sheet piles with steel girder edging. The firing bay is protected by a large earth traverse which incorporates discrete fuel bays and a semi-detached observation bay allowing viewing of the test by periscope.

We were able to scramble into the surviving parts of the test bay and climb up the overgrown ramp to the top of the stand; this is where the missile would have been lifted onto the stand by crane. We were also able to scramble into the control room which is at the southeast corner of the stand. This is a partially buried reinforced concrete building with a flat roof, protected by concrete retaining walls and the earth traverse. Racks of control and recording equipment are still in place.

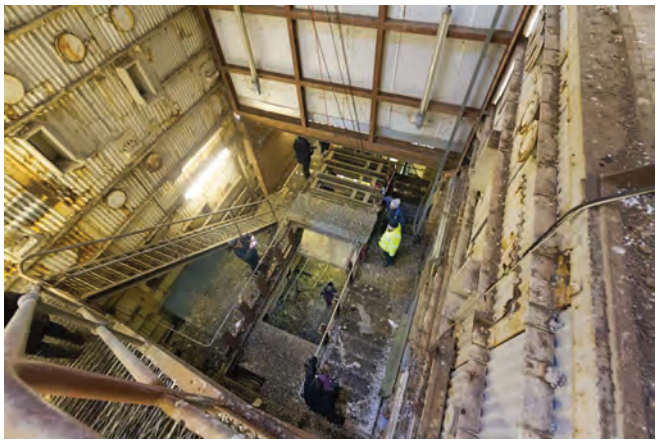
P 2 Site; P1 is seen to the rear

As built, P2 was identical to P1 but it later went through three stages of alterations to accommodate the missiles being tested. In the late 1950s the stand was heightened for trials of the Rolls-Royce RZ1 engine which was tested approximately five hundred times. After modifications, the engine became the RZ2 which was used to power the Blue Streak intermediate ballistic missile and, later, the Europa 1 three-stage space rocket which incorporated Blue Streak into its first stage.

The stand was further heightened and clad in corrugated metal sheeting in the mid-late 1970s for drop-testing the

P2 – the corrugated metal sheeting was added partially to hide Chevaline Polaris. The octagonal concrete segments in front of the stand are part of the $^1/_6$ size Blue Streak silo

The present entrance to P2 was the original exhaust gas outlet



Looking down through the floors from the top level of P2. Photo Chris Howells

top-secret Chevaline Polaris missile. The cladding was required partially to hide the Chevaline.

The stand currently houses CCTV and communications equipment for the Westcott Venture Park and it therefore remains in good internal condition and is lit and securely locked. Our access was through double metal doors at the bottom of the southwest side. This entrance was the original exhaust gas outlet. Internally the building has partial floors linked by metal stairs.

The partially buried control room is at the northwest corner of the stand. According to the Historic England listing summary this still contains much of its equipment dating to the Chevaline period. Our inspection revealed two empty equipment cases and a desk and nothing else! In a bay at the base of P2 some octagonal sections of a $^1/_6$th-scale missile silo for Blue Streak are stored. These have no connection with the test stand.

Access all Areas

A short drive to the north end of the north–south runway brought us to our final site of the day which is known as '6 Site'. This site was brought into use in October 1950 and was a testing bay for either solid or package liquid motors. The bay was constructed of steel piling roofed over with old railway lines.

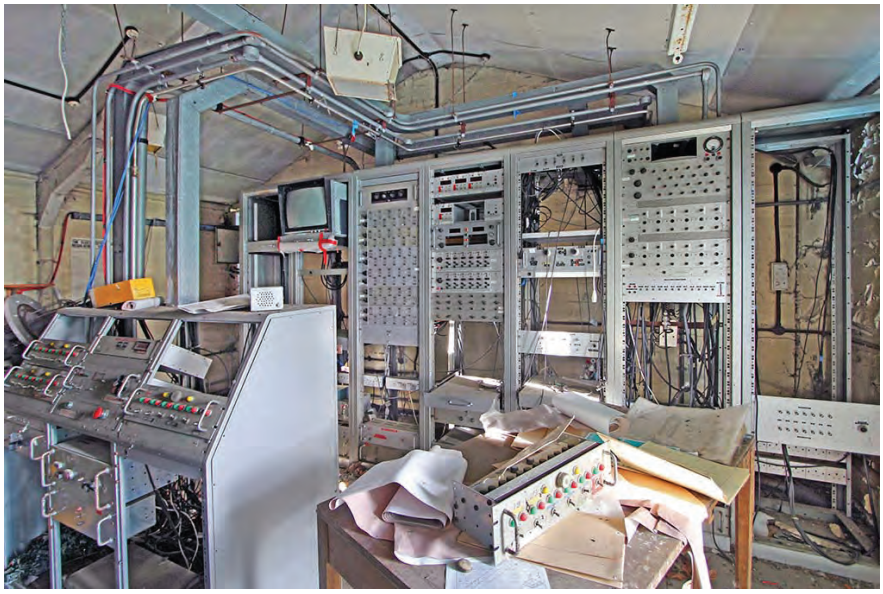
In the 1970s a new facility was built comprising three cylindrical vacuum firing tanks. Two of these were for testing motors at simulated high altitude or, in a vacuum, a third was for testing motors underwater. In these tanks it is possible to simulate underwater firings by increasing the pressure within the tank or by decreasing the pressure to simulate upper atmosphere firings. The tanks were former reaction vessels acquired from a chemical works.

One of the pressure tanks at '6 Site'. A second tank is seen to the rear of the building. This has now been removed. Photo Ed Andrews

The control room, recording equipment, workshops and pumps were located in a single-storey brick building alongside. Vacuum 1 was brought into use in July 1972, Vacuum 2 – which was at right angles to Vacuum 1 – in September 1975, and the underwater tank in October 1973.

Internally the building is in a dilapidated state with numerous papers relating to the work undertaken at '6 Site' strewn across the floor. Most of the control and recording equipment is still in place and the one surviving pressure tank stretches the full length of the building to the rear. One of the other tanks was later sent

The surviving pressure tank and workshop at '6 Site'



to the Martin Baker company at Chalgrove Airfield in Oxfordshire which specialises in making ejection and crashworthy seats.

Once everyone had had their fill we drove in convoy back to the reception car park at the end of a very informative day. The Westcott Venture Park with its unique Cold War buildings is a secure site and casual visitors would not be welcomed. Chris Kenny is trying to arrange a return visit to Westcott for members in 2017.

Black and white archive photos from Ed Andrews collection

Recent photos by Nick Catford unless stated

SOURCES:

Historic England documents relating to the listing of individual test stands at Westcott

Wikipedia (various pages)

Ed Andrews

Westcott a Chronology by John Harlow, former Head of Liquid Engine Development. Unpublished 78-page document.

Former Rocket Propulsion Establishment, Westcott. Its history and context. By Wayne Cocroft and Veronica Fiorato - July 2012 (Unpublished report following site visit in 1990s)

Much of the control and recording equipment is still in place

The City of London's Underground Golf Course

Stewart Wild

As many members know, I will always go that extra mile to find an underground drinking hole. That is how, in the interests of research, I came to pay a visit to Swingers, in the heart of London's financial district.

Now I know what you're thinking, but it wasn't like that. Swingers is a new entertainment venue that opened in May 2016 at Brown's Buildings, St Mary Axe, on the south side of the Gherkin. But what makes it interesting is that it's set forty feet underground in a vast World War II air-raid shelter, now, of course, extensively refurbished.

A London entrepreneur, Matt Grech-Smith, was successful in 2014 when his company set up two pop-up mini-golf venues in east London. Thus encouraged, he spent 18 months converting a dingy old basement air-raid shelter in the heart of the City of London into an entertainment complex with several bars and two nine-hole crazy-golf courses.

The 16,000 sq ft venue has a two-storey clubhouse with bar on each level serving golf-themed cocktails. There's also the Fairway bar at the start of the Windmill course and the 10th Hole at the end of the Lighthouse course.

Apart from a wide range of cocktails, Swingers also serves a range of beers including pints of Greenwich Meantime (£5.50) piped straight from giant tanks – there's an excellent, if pricey,

The Gin Terrace overlooks the Lighthouse Course

wine list too – while three independent food vendors provide a food court area for sustenance from noon until midnight, one serving up pizza, another burgers and the third one a kebab restaurant.

A round of golf is optional, at £13 per person if booked in advance, or one can just pop down for a drink, as I did. It was good to see imaginative use made of an old WWII bunker, even if few of the staff were aware of how the place saved countless lives during the Blitz 75 years ago.

Further information: The Crazy Golf Club: swingersldn.com

The Chesterfield Canal and the Norwood Tunnel

Rod Auton – Publicity Officer for the Chesterfield Canal Trust

Looking east along the tunnel towards the portal in August 2016; the good condition of the brickwork is clearly seen. 230 painted on the wall indicates 230 metres from the portal. Photo John Lower

The Canal and River Trust (C&RT) aims to inspect all its tunnels every ten years. Our own disused Norwood Tunnel was due for inspection last year, but this was deferred. We thought that it was not to be done until December 2016, so you can imagine our delight when we heard that it had been brought forward to the end of August.

Tunnel inspection in the winter of 2002/3. Photo Mike Sampson

Access for the Trusted Few

We were asked not to make any announcements beforehand because C&RT did not want the place to be overrun, nor for uninvited guests to break in. They did however say that they would allow a strictly limited number of Chesterfield Canal Trust members to enter. They said that some of their own staff would also be entering. We agreed that our Work Party would be the first in line, plus a few others including long-term campaigners and those with specialist knowledge.

Stephen Hardy, the C&RT Press Officer, did a superb job inviting the media. Both BBC *Look North* and ITV *Calendar* sent camera teams. Each went for trips inside and there were pieces on both channels that night. BBC Radio Sheffield also sent a reporter and her piece hit the airwaves a couple of days later.

The previous day (Monday 22 August), some contractors broke down the wall that seals off the tunnel and built some steps and a handrail down from the towpath. I went to have a preliminary peek and was stunned at how good the tunnel's brickwork appeared to be. On the Tuesday

BBC Look North interview taking place. The temporary steps built by the contractors are seen. Photo John Lower

ITV Calendar News team prepare to enter the tunnel. Photo Rod Auton

morning, the C&RT tunnel inspectors went in for a preliminary survey and set up a communications system – phones and radios were likely not to work.

Electric Boat

They had brought a small inflatable boat with an electric outboard motor with room for three people. Given that one had to be an engineer, there could only be two passengers at a time. The trips then started. The media went first, then the C&RT staff. Richard Parry, the Chief Executive of C&RT, asked the engineer how the tunnel measured up to the other tunnels that are in use every day. The reply came that it was in much better condition than many of them!

John Lower and Richard Parry (CEO of the Canal & River Trust) set off into the tunnel. As there is insufficient room to turn the boat it was backed in. Photo Rod Auton

Wednesday dawned hot and sunny. The engineers went in first to finish their inspection work; then it was our turn. I was lucky enough to be on the first trip, because I had been given a special camera to make a video. It was stunning. The brickwork is superb, except for a few cracks in the mortar that can be easily repaired. It was cool – very welcome – and the stalactites at around 100 metres in were amazing, some nearly a metre long.

Every ten metres, the distance from the portal is painted on the wall, so you always know exactly where you are. We went to 440 metres in, which is as far as boats can go. Here there is a sunken pan and then a layer of silt. Apparently the first roof collapse is about 50 metres east of Hard Lane. There is no room to turn the inflatable round, so you reverse in and go forwards on the way back to allow an expeditious emergency egress. Turning round, I was amazed at how close the portal seemed. The tunnel has slight waves in the walls, notably at 200 metres in, but these are not noticeable at a distance – it appears to be dead straight.

The tunnel is navigable for 440 metres. Beyond that the tunnel is blocked by a sunken pan; beyond that the first roof fall is soon reached. Photo John Lower

The engineers carry an air monitor with them in the boat, which beeps continually. Periodically, they report back to the guys at the portal saying where they are, what they are doing and what the readings are on the monitor. When we arrived back at the portal, I was amazed to discover that we had been gone for nearly half an hour – it felt more like five minutes.

On the Thursday, the tunnel was again bricked up all too soon. We can only hope that it will be a lot less than ten years before it is next opened and that it will not be subsequently resealed at all. We are very grateful to C&RT for allowing us to visit the tunnel. Like their lock open days, this is a sign of how they are opening up their operations to the public. They are to be congratulated upon such enterprise – long may it continue.

Returning to the mouth after the half-hour trip into the tunnel. Photo Rod Auton

Chesterfield Canal History

The Chesterfield Canal was opened in 1777 and ran for 46 miles from the River Trent at West Stockwith, Nottinghamshire to Chesterfield, Derbyshire. It is currently navigable as far as Kiveton Park near Rotherham, South Yorkshire, plus an isolated section near Chesterfield. The canal was built to export coal, limestone and lead from Derbyshire, iron from Chesterfield, and corn, timber and groceries into Derbyshire. The stone for the Palace of Westminster was quarried in North Anston, Rotherham, and transported via the canal in the 1840s.

The route of the canal was surveyed by James Brindley and John Varley, who estimated the cost at £94,908 17s. Brindley presented his proposals to a meeting in Worksop on 24 August 1769. Bawtry interests asked John Grundy to carry out a second survey. This was because Bawtry was, at that time, a considerable port and received goods brought by pack-horses from Chesterfield.

Grundy proposed a rather shorter course, from Stockwith via the River Idle to Bawtry and then by Scrooby, Blyth and Carlton, to join Brindley's line at Shireoaks. Grundy's line was 5½ miles shorter, and the cost estimated at £71,479 6s 9½d. Although Grundy's line was considerably cheaper, it achieved this by missing Worksop and Retford, and the investors had already decided in favour of Brindley's route.

An application was made to Parliament and received the Royal Assent on 28 March 1771, entitled 'An Act for making a navigable Cut or Canal from Chesterfield, in the county of Derby, through or near Worksop and Retford, to join the River Trent, at or near Stockwith, in the county of Nottingham'. Immediately on the passing of the Act, construction began under the direction of Brindley.

Upon Brindley's death in September 1772, John Varley moved from Clerk of Works to Resident Engineer with Hugh Henshall, Brindley's brother-in-law, appointed Chief Engineer in 1773. The canal was to be built as a narrow canal, but in 1775, nine shareholders offered to fund the extra cost of making it a broad canal from Retford to Stockwith. Retford Corporation joined them, and each contributed £500. The additional cost exceeded £6,000. The canal was opened throughout in 1777, but the only record of wide-beamed boats using it at Retford is prior to 1799.

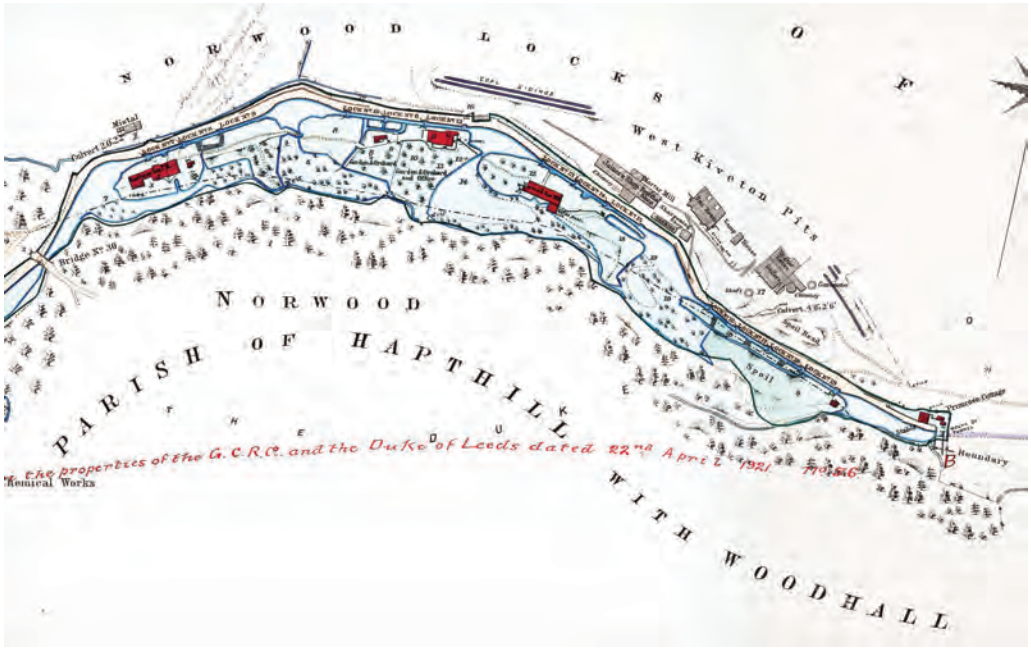
A loaded narrow boat has just passed under Wharf Bridge, Misterton, near the junction with the River Trent, circa early years of the 20th century

As built, the canal was almost 46 miles long, being 25 miles from the Trent to Worksop with a rise of 95 feet. From Worksop to the entrance to Norwood Tunnel it was 6.1 miles with a further rise of 145 feet. From here to Chesterfield it was a further 13.9 miles with a fall of 73 feet followed by a rise of 40 feet. The canal was not a typical Brindley contour canal, in that it incorporated some major embankments, e.g. Staveley Puddlebank, rather than always following the contours.

Norwood Tunnel

There were 65 locks in total but the main engineering feature on the canal was Norwood Tunnel which is equal longest of the tunnels built during the pioneering era of canals in this country. At 2,880 yards, it is the same length as Brindley's Harecastle tunnel on the Trent and Mersey Canal in Staffordshire, which by coincidence opened just ten days later.

When he was planning the waterway in c1768, geography dictated that it would have to cross a limestone ridge. There is some suggestion that Brindley originally intended to carry the canal over most of the coal measures with a short summit tunnel of around 630



The Norwood flight of three triple and one quadruple staircase locks leading up to the Western portal of Norwood Tunnel. Railway map dated 1892

yards. This would have given a summit pound of circa 2½ miles. He chose to drive the tunnel in the Kiveton Park and Wales area where the ridge is at its narrowest.

It seems possible that the longer tunnel was foisted on Brindley partly by the wishes of the local landowner, the Duke of Leeds, and partly by a reconsideration of the water supply needs of the summit pound. Tunnelling was expensive, time-consuming and dangerous, all of which had to be weighed against great water-supply benefits.

The longer the tunnel, the longer the canal could keep to one level and water would not be lost as boats climbed up and down through numerous water-thirsty locks. Although Brindley would have known nothing about geology, his route actually took the best route over the limestone ridge using modern geological knowledge.

Construction begins

The construction work on the tunnel was started in 1771 with the laying-out of a surface transect followed by the sinking of a series of vertical shafts to the depth of the tunnel. From the base of each shaft, headings were driven east and west to intersect with the headings from adjacent shafts to form the main bore of the tunnel.

The number of shafts used is not known – some have been plotted and the location of others estimated, but whether original or dating from later major works is not clear. Some construction shaft mounds and the earth rings which mark the site of horse gins (winding wheels) can be seen above the eastern end of the tunnel between Hard Lane and the eastern portal.

A visitor to the canal in 1774 was told that these shafts were to be bricked up and infilled. Many do appear to have been infilled but at least one was left open. This was a large shaft near the centre of the tunnel. When woodland was planted adjacent to it this became known as 'Open Shaft Plantation' and was marked thus on the 1870 edition Ordnance Survey maps. It was still shown as such on the 1970 OS map.

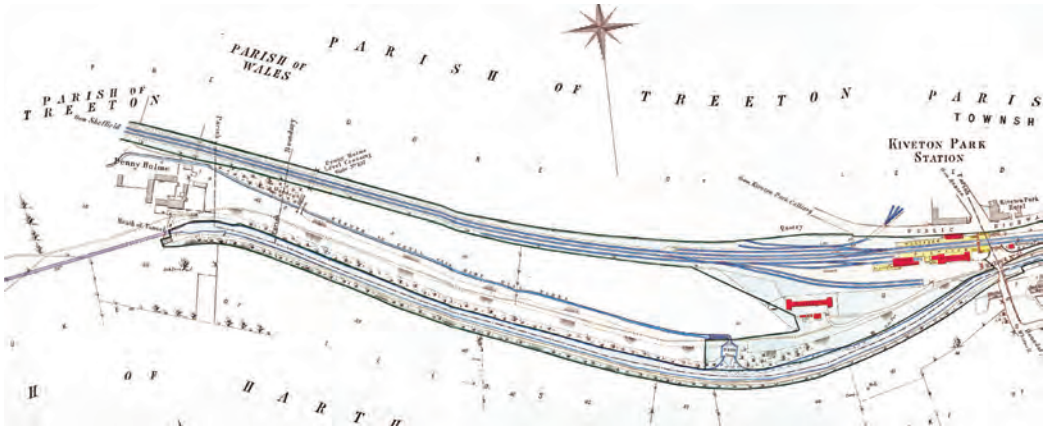
Three Million Bricks

These construction shafts were used to lower bricks, most of which were made locally, to the tunnel works. In January 1772 contractors were sought to provide three million hand-made bricks for the lining, and local colliery owners were asked about supplying coal for the fifteen brick kilns which would be on the surface along the whole length of the tunnel. Vast quantities of clay suitable for bricks, and limestone to make mortar, also had to be found in the area.

The Western portal of Norwood Tunnel in 1903; note the tunnel-keeper's house just visible on the left

The big challenge of a canal tunnel was to keep the level accurate – it could not follow a seam of minerals, instead it had to be level and of uniform bore no matter what material was found in the hill. And with geology in its infancy no one knew what that may be. This is why Norwood and Harecastle tunnels were enormous challenges for the engineering techniques of the day, and a double headache for James Brindley.

What we do know about the shafts is that they were dangerous places. John Hutchinson of Wales was killed as he was lowered down, leaving a widow



The eastern portal of Norwood Tunnel shown on a railway map dated 1892

with a large family of small children. In contradiction of the modern uncaring image of canal companies, the Management Committee authorised the payment of five guineas to Mrs Hutchinson to help with the upkeep of her now fatherless children.

Dangerous work

Not long afterwards Edward Bunting was severely injured – standing at the bottom of a shaft he was hit by a large basket of rocks which, being hauled to the surface, broke free and crashed down on to him. He was taken to Harthill and put to bed at one of the inns. They called for medical attention but the surgery and drugs applied by Dr George Frith were to no avail; Edward Bunting died and was buried in Harthill's parish churchyard. Again the Canal Company showed a caring face: after his death, paying the bills outstanding for his accommodation and medical treatment.

The eastern portal of Norwood Tunnel in 1959.
Photo courtesy Inland Waterways Protection Society

The origin of the men who built the tunnel is not known. Although John Hutchinson was described as "of Wales" it may not mean he was a local man [*Editor's note*: Wales here refers to a village near Kiveton rather than the country]. He may have moved to the area with his family, drawn by the work.

The same may apply to Edward Bunting. The only other names known are those of the contractors who undertook the work, who individually agreed the payment for which they would complete a section, but who they employed is not known nor their own origins.

It is believed however, that some of the tunnellers, and some of the navvies building the rest of the canal, came from the North East, where coal mining was common. It is also believed that many of these North Easterners stayed on afterwards and expanded the local coal mining industry in south Yorkshire and north Nottinghamshire.

The management of the project appears to have been lax and blame has been attached to John Varley. This was revealed when, after Brindley's death, Hugh Henshall took over responsibility for the construction. However, it should be remembered that Varley also had to oversee the construction of the canal which was stretching to the eastwards away from the tunnel.

The western portal of Norwood Tunnel in the first decade of the 20th century

No canal tunnel of this magnitude had been completed in Britain, so Varley and the contractors had little prior experience to guide them. It was dangerous work in the hot tunnel, using gunpowder by candlelight, and the company accounts include funds for the 'liquor given to the workmen at the tunnel' – which may or may not have improved their safety!

The canal opens

Norwood tunnel was completed in 3 years and 6 months, and the first boat passed through on 7 May 1775. Only two days later, Hugh Henshall led the official opening ceremony when three boats took three hundred people, including a musical band, through the tunnel in 61 minutes, although the numbers may be journalistic exaggeration. As there was no towpath the boats had to be propelled by their crews, presumably by "legging"

them through but no details were recorded. Legging is the process of pushing against the walls or roof of a canal tunnel with one's legs in order to propel the narrowboat through the tunnel.

The construction of Norwood Tunnel was of national importance. It proved that such engineering was possible and thereby encouraged people to invest in the later canals, which eventually formed the transport network which made the Industrial Revolution possible.

The tunnel was nine feet three inches wide and 12-ft high. The western portal is in Norwood, Derbyshire and its east portal in Kiveton, South Yorkshire. The tunnel forms a large part of the four-mile-long summit pound of the canal, with Norwood Locks descending from the west portal and Thorpe Locks descending beyond the east portal. The portals each had retaining wing walls – local sandstone at the west end and limestone blocks at the east end.

The portals had an extremely functional appearance and lacked any ornamentation or decoration. The main water supply for the canal came from Pebley Reservoir, but this proved inadequate, so further reservoirs at Woodhall and Killamarsh were constructed in the 1790s and three more at Harthill in the 1800s. At the end of July 1775 an auction of the equipment that had been used to construct the tunnel was held at the eastern portal.

Other tunnels

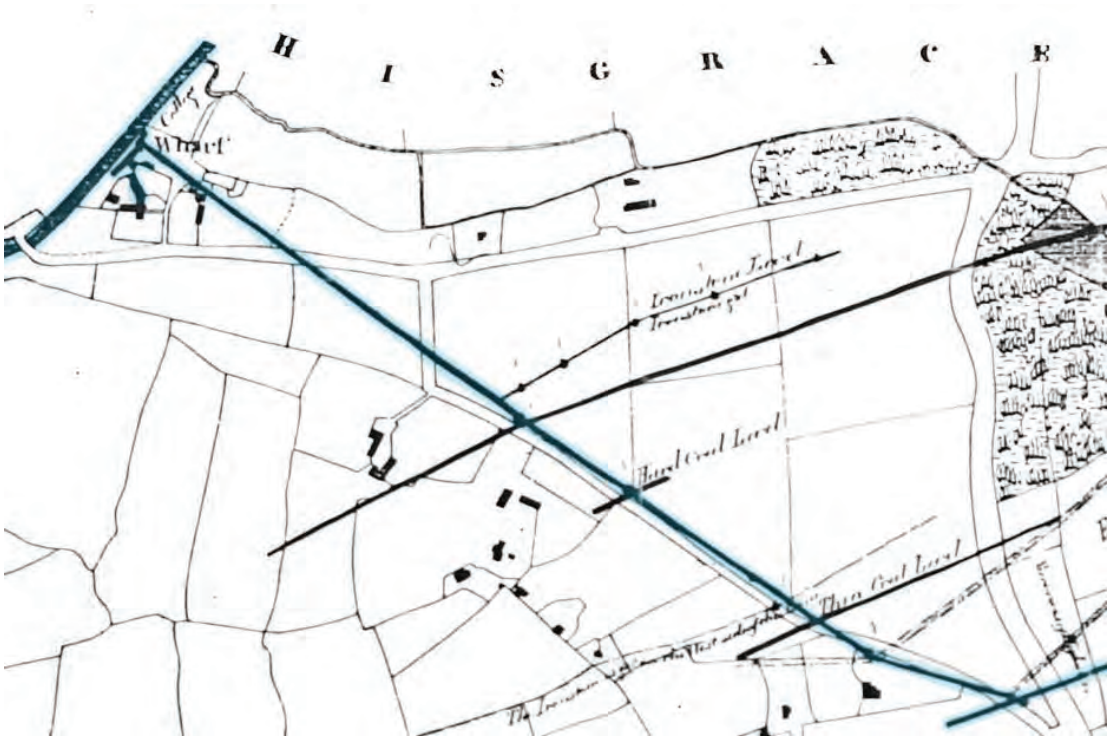
The Chesterfield Canal also had a second tunnel near Gringley Beacon known as Drakeholes Tunnel. This is a shorter tunnel being just 154 yards long and also built without a towpath. It is located between Norwood Tunnel and the River Trent.

As well as the two tunnels on the canal itself there was also the 1¾ -mile-long Hollingwood Common Tunnel which was actually a navigable colliery adit which terminated at a trans-shipment wharf on the west side of the original alignment of the Chesterfield Canal through Staveley Works. The tunnel served coal workings in the vicinity of Ringwood Hall. The water level in this tunnel was one foot lower than that of the canal achieved by means of a culvert under the canal, requiring the trans-shipment of coal at the terminus. The tunnel and colliery were owned by the Duke of Devonshire and operated by his colliery agent George Dickins.

After three hundred yards the tunnel reached the Squires seam and was used for draining and working that and two nearby coal seams, producing good coking coal much of which was bound for markets in Nottingham and Lincolnshire. At its south end, the tunnel is some 240 feet below ground level. The tunnel was brick-lined throughout apart from a 68 yard section in the middle which was driven through grit stone which didn't require any additional support for the brick arching. The tunnel was ventilated by 7 air shafts along its shallow length south from the Chesterfield Canal.

The tunnel is 6' high, 5' 9" wide with water 2' deep. The boats used were loaded underground within the mine; they were 21 feet long and three feet six inches wide and had a maximum capacity of 14 hundredweight of coal spread over 7 boxes. Because the tunnel was at a lower level than the canal a crane was used to hoist the boxes up to canal level and empty the contents into 70' narrowboats which had a capacity of 20 tons.

The closure date of the tunnel is not known but there is no trace of the transhipment wharf on the 1876 Ordnance Survey map. The Chesterfield Canal was realigned to the south of Staveley Works by the Manchester, Sheffield and Lincolnshire Railway in 1892 due to the inconvenience of having the canal running through the middle of the works. The junction between the tunnel and the canal and the north end of the tunnel was swept away during this work.



Plan of the north end of the Hollingwood Common Tunnel. The transhipment wharf at the junction with the Chesterfield Canal is seen on the left.

In 1991 the shallow Hollingwood Common Tunnel south of the 1890s Chesterfield Canal deviation was excavated. Photo Rod Auton

The last recorded access to the tunnel was in 1912 when visited by a local man NS Purcell and a Staveley official Captain F M Dick. Messrs Purcell and Dick rigged climbing tackle across the top of one of the ventilation shafts close to Westwood. They were, in turn, lowered to the bottom and explored the Hollingwood Tunnel for some distance. They found it in a good state of preservation.

In 1991 there were plans to construct a bypass at Brimington. As this would have run above the tunnel an inspection was required to ensure that it was safe to build the road over the tunnel. The tunnel on the south side of the 1892 deviation was excavated but it was found to be impassable after a few yards because of the build up of silt to within six inches of the roof. There was a water flow over the top of the silt.

The Coal Authority, which is responsible for keeping all mineshafts safe, saw an article about the excavation of the tunnel and came to investigate. As a temporary measure the tunnel entrance was cleared of vegetation and fenced. The brickwork around the entrance was then repaired and a grille was fitted across it in 2012. The site is not accessible to the public.

In 1991 the Hollingwood Common Tunnel was found to be heavily silted and soon became impassable. Photo Dave Penney

Quickly into decline

The canal was initially fairly successful, with dividends being returned to the investors. The first sign of problems came in September 1777 when a nineteen-yard section of roof was damaged due to the removal of coal in the overlying ground leading to the unloading and weakening of the tunnel arch (it effectively 'burst' upward as lateral pressures exceeded downwards compression forces on the arch).

There was also a frequent shortage of water in the summit pound. When water was in short supply, boats were only allowed to carry a maximum of 16 tons; in 1810 boats were only able to use the tunnel to go east and west on alternate days.

The building of the Manchester, Sheffield and Lincolnshire Railway (MSLR) line parallel to the canal left much of the navigation redundant, and the MSLR purchased the Chesterfield Canal in 1847. It has long been claimed that the tunnel was lengthened/shortened when the railway was built, but a map of the 'proposed' Manchester & Lincoln Union Railway, 1845, shows the portals in their current locations.

Raising the roof

Coal mining-related problems continued and from the 1860s onwards a large colliery was developed above the tunnel, operated by the Kiveton Park Colliery Company. The removal of coal from seams under the tunnel caused major subsidence problems – segments began to sink. As the water level was constant the roof became nearer to the water surface and the tunnel became progressively more difficult to navigate.

The western portal of Norwood tunnel in 1959. Photo courtesy Inland Waterways Protection Society

In January 1871 the MSLR started what would be twenty years of roof-raising to keep Norwood Tunnel passable. The total cost was £17,043, said to be £7 per linear yard. The raising of practically the whole length of the tunnel

roof was done by prolonging the side walls and rebuilding the semi-circular arch.

The process was interrupted in 1875 when a major collapse took place in the area immediately south of Wales around Open Shaft Plantation. This was subsequently opened out into a short cutting with two new tunnel portals being formed at each end of the breach. The opportunity was taken to widen the canal channel at the breach and it appears to have been possible for two boats to pass. The cutting also appears to have been used to lower construction materials to the tunnel relining works below.

The tunnel collapses

After days of heavy rain a 12–14 yard section of the tunnel collapsed on 18 October 1907, leaving a large hole in a field near the road to Harthill. With only minimal boat traffic on the declining canal the cost of repairing the fall could not be justified and the tunnel has remained blocked ever since, splitting the Chesterfield Canal into two sections. The stretch between the tunnel and Worksop subsequently fell into ruin and became un-navigable, while parts of the isolated section from the tunnel to Chesterfield were infilled and redeveloped.

In January 1919 a mining engineer, Mr Perkin, stated, "to make the tunnel navigable would... practically entail its reconstruction". The most practical course would be to open out some lengths, with the rest reconstructed with sufficient headroom to allow for future subsidence. The two portals were sealed by British Waterways (predecessor to the C&RT) in October 1962.

The eastern portal of Norwood tunnel in the early 1960s, shortly before the portals were sealed by British Waterways

The Open Shaft Plantation cutting was eventually infilled with colliery waste with the expansion of the Kiveton Colliery south tip. It now lies under the reclaimed Kiveton Community Woodlands Park. In the area adjacent to the Kiveton Waters Ponds the tunnel was removed by the driving of a drift mine adit in the 1950s; large parts of the original tunnel were excavated away and those areas with exposed voids were infilled with concrete.

From the eastern edge of the drift mine adit to around 50 metres east of Hard Lane the tunnel has collapsed. Beyond this point to the east portal the tunnel is intact and in good condition, possibly because it is within the protected zone near the railway which was not mined.

Restoration

In 1961, the entire length of the canal was proposed for official abandonment, but protests meant that under the Transport Act 1968 it was classified as a cruiseway between the Trent and Worksop, while the rest was classified as remainder. Restoration efforts began in the 1970s, with the Chesterfield Canal Society formed in 1976, focusing initially on the route east from Norwood Tunnel to Worksop, which presented relatively few physical obstacles to being restored to navigation.

However, in practice progress was slow, and attention turned to the section west of Norwood Tunnel, where much more damage had been done to the canal bed, which had been filled in and built over in many places. However, the last five miles of the canal, from Chesterfield to Staveley, remained in water, and restoration began in 1987, with Tapton Lock being reopened in 1990.

Derbyshire County Council acquired the section of canal between Chesterfield and Staveley, initially in order to build a road over it. This fell through (figuratively speaking) and the council later secured several large grants to begin major restoration works.

The west portal of Norwood tunnel in 1978. Through the bars it is possible to see that the tunnel roof has collapsed within a few metres. Photo Nick Catford

Over a ten-year period, four locks were restored by volunteers from the canal society, who also built a fifth from scratch after the original had been swept away by opencast mining. Three new bridges were built, with the five-mile section from Chesterfield being reopened to navigation in 2002, though still isolated from other waterways.

A breach in the canal in early 2007 forced temporary closure of all but the top pound of the canal above Tapton Lock. The canal's restored western section has now reached Staveley and a new mooring basin was opened there in 2012. Currently restoration efforts are centred on creating a drop in the canal's water level just north of the basin, via a new lock, again built by volunteers, to allow boats to pass under a rail bridge which was

constructed very close to water level. Another new lock will lift the canal back to its original level on the other side of the bridge.

East of Norwood, Derelict Land Grants were obtained by Rotherham and Nottinghamshire councils in 1995, and restoration between Norwood and Worksop began in earnest. In 2003, the Worksop to Norwood Tunnel stretch of the canal was reopened, with an impressive thirty restored locks, one new lock and three new bridges. The Chesterfield Canal Trust is a charitable company run entirely by volunteers, incorporated in July 1997. In 1998 it took over the assets of the former Chesterfield Canal Society.

Tunnel Vision

The most difficult part of the restoration project, linking the two reopened sections, remains, with nine miles of canal to be restored or rebuilt, including the length of the tunnel. A significant diversion will be needed around the village of Killamarsh, where a housing estate has been built on the line of the canal. The middle section of the tunnel was lost to coal mining, and as part of the reclamation of the derelict mining area, the canal will be rebuilt in the open air, probably at a higher level with locks at each end. The eastern end of the tunnel (as surveyed in August of this year) will be retained.

The intention is to use this first 400-metre section of the tunnel and bring the canal through this short fragment and out of the existing east portal of the Norwood Tunnel into the cutting west of Kiveton Park station. This is the current head of navigation from West Stockwith. Thereafter the canal will rise to the surface via a triple staircase of locks.

Kiveton Waters Fishery was constructed to be a marina when the canal arrives or, more correctly, returns. Three

Tapton lock in Chesterfield was the first lock to be restored by the Chesterfield Canal Society. It reopened in 1990. Photo John Monk

further locks will bring the canal to the M1 motorway, under which the canal will run through Poplar Farm underpass. Two further triple-staircase lock flights will take it back to the level of the western portal.

At present the western tunnel arch is infilled with red brick with a single rectangular opening in the middle of the blocking wall. This opening is closed with a series of vertical bars. Through the bars it is possible to see that the tunnel roof has collapsed within approximately five to ten metres of the opening.

So the day is in sight when a ground-breaking tunnel dating from 1775 and abandoned over one hundred years ago will once again become part of the UK's canal network rather than a couple of blocked-up portals.

Some historic details have been sourced from Wikipedia.

All uncredited photos and maps are from the Chesterfield Canal Trust.

All kitted up for the tunnels in the walls at St. Paul's Cathedral, London

Paul W. Sowan

The very thick walls of Christopher Wren's St. Paul's Cathedral are riddled with tunnels and spiral staircases, well beyond the parts visited by worshippers and tourists in their thousands. They were built into the fabric for workmen's access, and currently serve as routes for heating pipes and other services. In a few places there are small windows to the outside, such as in a tunnel around the walls of the apse.

In 2002 I had the opportunity to visit these spaces with the Cathedral's architectural archivist, and invited colleagues from Historic Royal Palaces (with whom I was at the time collaborating on the Reigate Stone Research Project) to accompany us. The purpose of the visit was to see where Wren had employed over £9,000 worth of Reigate stone in the 17th century building works. This had been quarried, almost certainly underground in or near Reigate, by quarrymen such as Augustus Parker of that place, between 1678 and 1706.

We met in the masons' yard (below the pavement on the north side of the building), got kitted up with overalls, helmets and lamps, and emerged into the crypt, getting some odd looks from the tourists. Photography is banned inside the building (unless, I expect, you buy a permit) but we were deemed to be exempt as we were going to places between the inside and the outside! Then we disappeared into the walls, taking the lift (I didn't know there was one!) to the Architects' Department and then into the intramural voids. Apart from a high-level traverse across the south wall of the south transept, and a few other points from which we could look down intro the nave, we were right out of sight.

What we saw was very impressive. Huge quantities of Reigate stone in very large and very precisely squared stone, in excellent condition: Wren knew what he was doing, as on the outside of the building exposed to the weather it would no doubt have crumbled by now. In a tunnel around the apse the stones are cut precisely to fit the curve. This very fine masonry is quite invisible to normal visitors, who see little but Portland stone from Dorset either inside or outside the building. No expense was spared! Wren, also, used a number of other stone types for special purposes inside the fabric, including for example hard chalk (also from underground quarries at Beer (Devon) and Guildford (Surrey)).

Some sites at the Clee Hills and Snailbeach, Shropshire

Paul Sowan

The impressive industrial landscape remaining at Titterstone Clee Quarry

The Association for Industrial Archaeology's 2016 annual meeting was based at the Telford Campus of the University of Wolverhampton for six days in September, during five of which members had a choice of visits to industrial sites, some still active, in Shropshire and neighbouring counties. Several sites depended upon the extractive industries, such as a working pottery at Stoke on Trent and the Broseley Pipe Works Museum near Ironbridge, both of which used clays as a raw material. A spectacularly working iron foundry at Coalbrookdale, also near Ironbridge, uses limestone in manufacturing cast iron parts for Aga and Rayburn stoves, mostly from recycled brake discs and drain gratings. Two excursions were to areas more directly connected with mineral extraction, opencast and underground.

Clee Hill dolerite, coal and limestone

This elevated mass of limestone, coal measures, and dolerite offers extensive views of adjoining counties from the summit (a least, on a good day!) The dolerite, a hard black igneous rock used for surfacing roads, has been worked opencast near the summit, where massive concrete structures remain, reminiscent of the German erections on Alderney. Dolerite is still taken at a nearby active site, very noisily as the plant consists largely of stone crushers and grading plant. Below and around the dolerite outcrop the slopes are peppered with numerous depressions resulting from the falling-in of shallow shaft-accessed coal workings. The lowest hill slopes yielded limestone, and members were able to go underground in the collapsed entrance tunnel to a former limestone mine, although an examination of this very short accessible length of tunnel, just a few metres long, was accomplished in a minute or two. A rather fine farmhouse lunch washed down with locally made cider was much appreciated.

Lillieshall limestone mines

At Lillieshall, near Newport, Shropshire, members visited an archaeological excavation on private land below which lies an extensive albeit flooded limestone mine. There are three shafts located (now) in woodland, all of which are open but grilled. Although the shafts are flooded to within 20 metres of the shaft top they have been investigated to nearly 140 metres using a purpose built underwater camera. A local group has for some years been excavating and recording the foundations of surface buildings and structures interpreted as the remains of engines and pumps built to work and de-water the mine. What has been revealed, with some difficulty on account of a tangle of tree roots and extensive heaps of tipped waste, appears to be the result of several possibly short-lived phases of development and redevelopment at the mine.

The adit has collapsed behind the photographer

The short surviving limestone adit.

Volunteers working on the excavation of the pumping engine house at the Pitchcroft site at Lillieshall. The excavations of the early winding engine house have been backfilled

Snailbeach lead ore and barytes mines, Shropshire

The highlight for your scribe was a return visit to the abandoned lead and barytes mine at Snailbeach, eleven miles southwest of Shrewsbury. Previously, he had been into Roberts' level, including crossing a precarious 'bridge' over an open stope to access barytes workings. The 'bridge' was then no more than a very large irregularly shaped muddy lump of rock which had fallen down the stope, scrambled across at the risk of plummeting to the flooded lower workings.

An underground tour in Roberts' Level

Those visiting more recently have the security of a more modern purpose-made structure. The overground visit at Snailbeach, opted for by your scribe on this occasion, was well worthwhile as a result of all the excellent work of members of local caving and mining groups, including Subterranea Britannica member Mike Moore. The surface site is publicly accessible at all times, with interpretation boards relating to the substantial standing buildings and structures, reached at various levels on the hillside by more or less steep footpaths and steps. On advertised days, generally bank holidays and Sundays from June to October, some of the buildings are manned by volunteers who explain mining methods and displayed artefacts. When sufficient volunteers are present, guided tours into Roberts Level are on offer. Pre-booked groups can also be accommodated, and deep-level underground visits can also be arranged, these calling for appropriate equipment and expertise for vertical descents. This has deservedly been described as 'the best preserved lead mine in the British Isles' and is highly recommended.

The reconstructed wooden headframe over the George's Shaft at Snailbeach

Further information can be found at the website shropshiremines.org.uk or from tour coordinator Mike Moore at mike@moorebooks.co.uk (T) 01952 405105 or Steve Holding (T) 07850 492036.

All photos from Kelvin Lake - I.A.Recordings

Portsdown Hill Magazines – from Munitions to Monitoring (Palmerston Follies at Fort Widley & Fort Purbrook, Portsmouth)

Martin Dixon and Mark Russell

The tunnel to the emergency control centre from the main fort at Widley

Portsdown Hill is a ridge of high land about five miles north of the City of Portsmouth and its Naval Dockyard. A Royal Commission of 1859 determined that the existing outer defences – the so-called Hilsea Lines – were vulnerable to attack. If an invading army were able to land elsewhere and gain the ridge from the rear then developments in artillery (principally rifling of gun barrels) would put the whole city and dockyard within range.

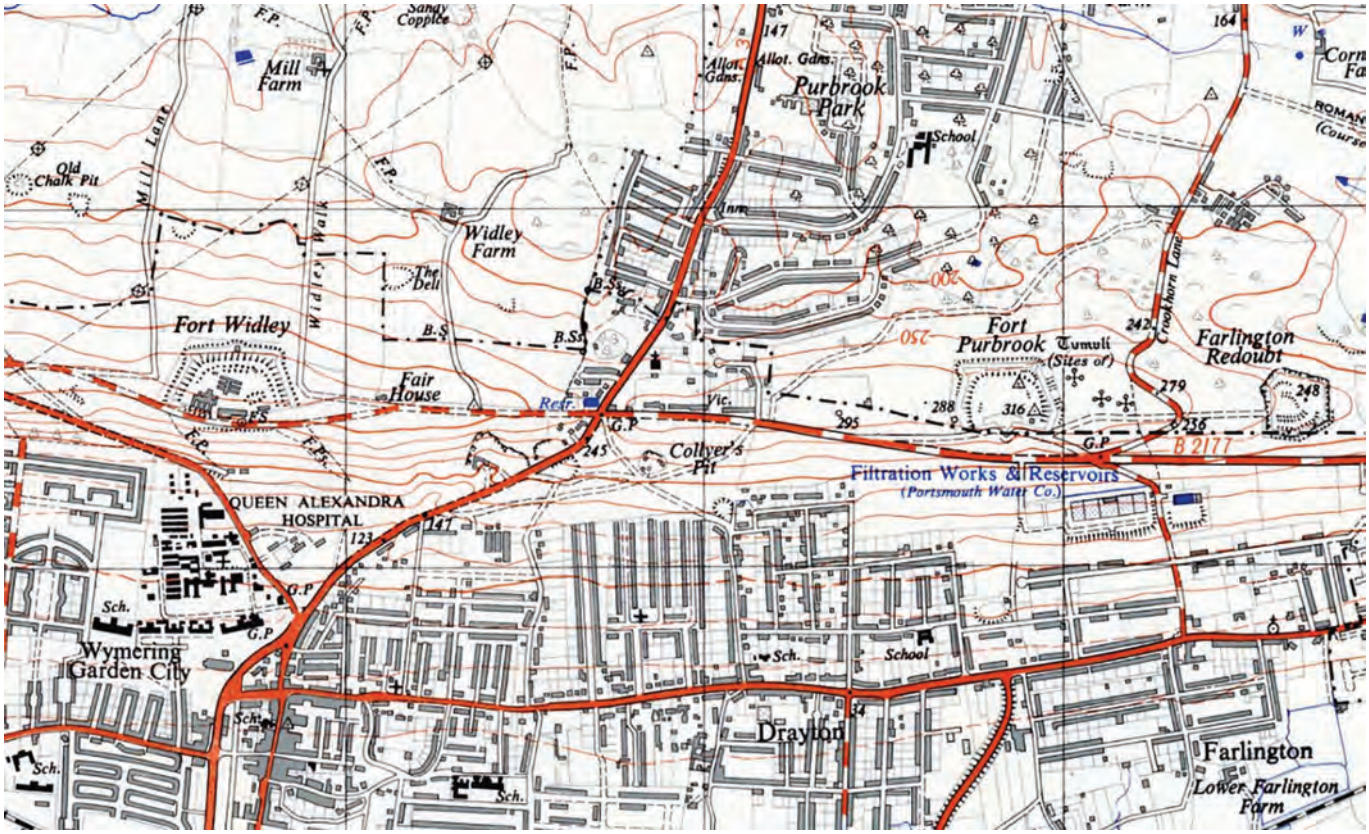
Palmerston's Follies

As a consequence six forts were built along the ridge to deny it to an invading force, named from west to east, Fareham, Wallington, Nelson, Southwick, Widley and Purbrook. They were popularly known as Palmerston's Follies (Lord Palmerston was the Prime Minister at the time) for two reasons.

Firstly there was a feeling that there was no real invasion threat and the forts were a waste of money (in a similar vein to opposition to today's Trident replacement programme). The second reason was that the forts had their artillery pieces facing inland and so it was thought by locals that they had been built back to front as everybody knew that France was to the south!

As a consequence of the increasing power of potential inbound explosive shells, the Portsdown Forts were amongst the first to have their main magazines completely underground, as opposed to within earth-covered semi-sunken structures.

Thanks to some legwork by Mark Russell, numerous letters, phone calls and emails, Mark and a small group (mainly Sub Brit members who have also been spending time working at the Wartling ROTOR bunker 'restoration') were able to visit two of the remaining forts and, in particular, areas underground not normally accessible to the public – including the Portsmouth Council Emergency Control Bunker. The very different current-day uses of the original magazines made for a great contrast.



1954 1:25,000 OS map showing the locations of Fort Widley and Fort Purbrook. To the east of Fort Purbrook, Farlington Redoubt is seen. This is one of two redoubts associated with Fort Purbrook and joined to it by a tunnel

A gun pit for a 68 pounder RML on the ramparts at Fort Widley; the gun would have faced inland. Note the parade ground in the background. The mound behind the emplacement is the top of the spiral staircase down to the main magazine (later emergency centre) and caponiers

The entrance to Fort Widley

Albert Hall

It was a very wet early-morning start on the Saturday when we all met our guide Maurice at Fort Widley. The panoramic view from Chichester Harbour in the east to Fawley in the west emphasised the strategic value of the ridge. The sky soon cleared and straight ahead lay Portsmouth itself and the Royal Navy dockyard and beyond, the Isle of Wight. The course of the Hilsea Lines could easily be seen just beyond the A27.

Imposing Fort Widley is built predominantly of local Fareham bricks – around ten million of them. The same Fareham bricks were used to build London's Albert Hall and as this contains 'only' six million bricks (plus four thousand holes, according to *The Beatles*); the scale of the forts can be imagined. The large surrounding ditch has panels of Sussex Flint; the knapping from these was used on the parade ground. Other building materials include lintels of Portland Stone, Scottish Granite around the gun embrasures and York Stone paving along corridors and walkways.

The whole structure is an impressive Victorian building, largely devoid of decoration apart from incised VAR (Victoria Regina and Albert) ciphers on either side of the main gate. Outside and to the east of this gateway was a line of garages, looking slightly out of place. These

Looking along the northern rampart at Fort Widley; a number of gun emplacements can be seen, all facing inland

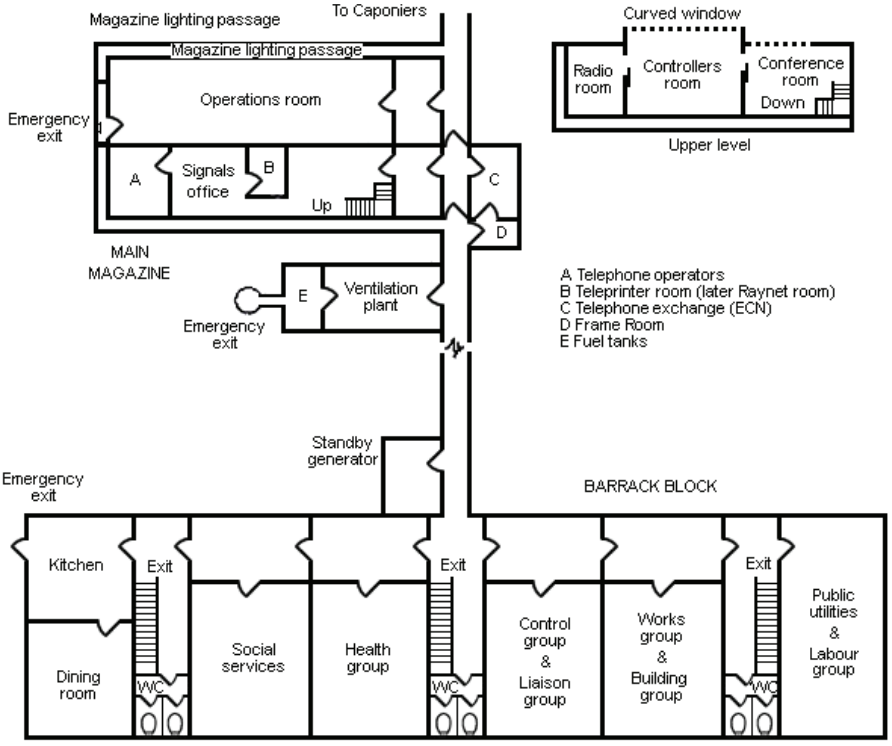
date from World War II when they housed an emergency fire-fighting depot and a bomb disposal unit. Postwar they formed part of a Civil Defence headquarters and one garage is currently used by the local sub-aqua club.

We entered the fort across a ramp which replaces an earlier horizontal drawbridge. The building is now owned by Portsmouth Council and leased to the Peter Ashley Trust who run activity centres for young people. Without further ado we descended into the basement of the barrack block to our left. Here, dating from the 1950s – a century after the original construction – we found directions to the support offices for the Portsmouth Borough Council nuclear bunker, for in the light of the threats of the Cold War, the borough had unusually decided to reuse the Victorian structure for the Portsmouth District Council Emergency Centre & Hampshire County Standby.

Cold War Protection

The support offices housing kitchen, toilets, health services, public utilities and so on were housed in the barracks block itself. We weren't able to access these but they have bricked-up windows providing some blast and fall-out protection but no air-conditioning. One window was left unblocked for use as an emergency exit; it originally led into a Nissen hut which would have acted as a crude decontamination unit. The hope was that blast protection would be provided by the surrounding fort walls but this was perhaps luckily never put to the test.

We then moved into the brick-lined tunnel leading to the original magazine. A square-section brick passageway took us from the basement to the original arched Victorian tunnels. We passed first a generator room and later a ventilation room on the left and on the right the start of a D-shaped 'by-pass' tunnel. This was original and allowed soldiers from the barracks block to reach the caponiers beyond without passing through the magazine and creating a risk of sparking.



The tunnel from outside the entrance to the control centre at Fort Widley. Note the switchgear on the left. Photo Nick Combes

Ventilation trunking is still in place and on the right was a mixture of electrical switchgear – the original with fine hand-written labels and its rather boring modern equivalent. Further on the right was a telephone exchange and frame room with its equipment still in place.

Entering the bunker proper to the left, we found a complete time capsule, lovingly maintained complete with some mannequins! The council's control room is in good condition with numerous artefacts in place.

The 'bunker' built into the original curved roof of the main magazines is over two levels 57 x 28 ft, around 30 ft deep. There is a superb Perspex viewing window still in place on the upper level including a rare surviving curved one in the controller's office with a radio room beyond.

Ground Control

The ground-floor Ops room would have housed the emergency services and Civil Defence desks which would have controlled the local authority area (ie Portsmouth) in the event of a major emergency, civil unrest or as during the Cold War, a nuclear attack from the Soviet Union. Portsmouth's Royal Navy base would have put the whole area right on the 'front line'.

The group exploring the Portsmouth Emergency Centre under Fort Widley. The controller can look down into the room from his office on the floor above

One end of the control room. All the rooms in the converted magazine have generally been retained as they were at the end of the Cold War with two mannequins now standing in the operations room to add to the sense of realism. This was done after closure of the Emergency Centre for the benefit of visiting school parties

The Ops room still has all the original documentation in place including radiation plotters, handbooks and message forms; the walls and maps are all still in situ including local areas of significance, in particularly military sites in the area, local and national ROC Posts. There were numerous maps in the control including a rare 'essential service routes' plan of the UK to be used by the military and other key personnel in the event of a nuclear attack.

At one end of the main Ops room was another blast door which entered into a small alcove where, if an emergency exit were necessary, the occupants would need to crawl through and up the ladder to the surface exit which came out in the parade ground above.

The complex remained operational until 1992 and is a beautifully preserved example of a local authority bunker. Sadly, in the past some of the artefacts have been taken by visitors as souvenirs and so viewing of the ground floor is usually limited to looking through the first-floor windows. We were lucky to be allowed (as trusted members of Sub Brit) to have free access to the whole bunker.

Looking northwest along the tunnel to the western caponier from the bottom of the spiral staircase. Photo Nick Catford

Caponiers

Leaving the bunker, we found there were three further emergency exits from the bunker along the original Victorian tunnels. Passing first through an air-lock, the original passage arrived at a circular junction from where a spiral staircase ascended to the parade ground above. The remains of a shell hoist could also be seen. We then continued along one of the three tunnels leading to the caponiers which would have provided fire directly into the defensive ditch. Some of these tunnels are in unlined chalk and they are still labelled with beautifully lettered enamel signs.

A gun position in a caponier at Fort Widley. Note the mounts in the floor to manoeuvre the gun

As we entered one of the caponiers, we could see it had been converted as accommodation during World War II. Fireplaces had been installed – small for other ranks and larger for the officers.

On exiting the caponiers we took a stroll along the top of the site, past the gun battery sites with views across the rear end of Portsmouth and the famous D-Day site of Southwick House in the background.

Fort Purbrook

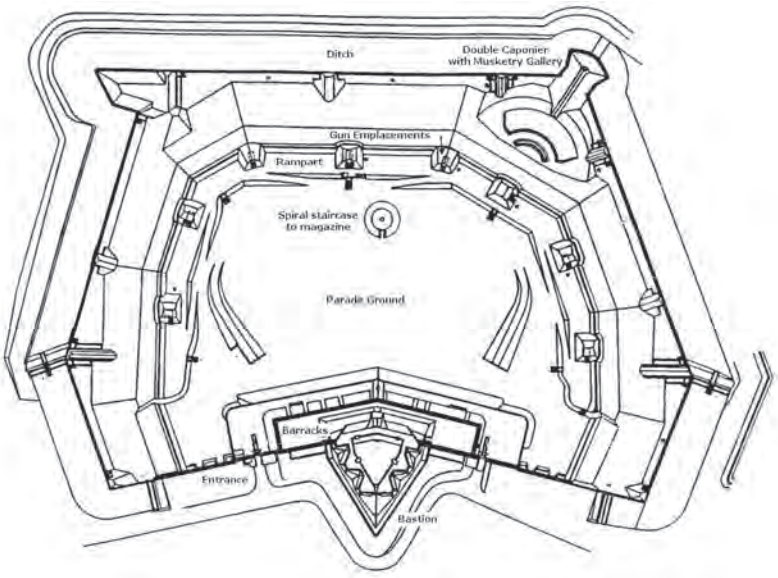
Having had a splendid morning's tour, we retired to local hostelries, or to the excellent burger van at the car park along the military road, and a group of us also sat outside the fort admiring the view overlooking Portsmouth while we ate our sandwiches. Suitably refreshed, we reconvened at Fort Purbrook – about a mile to the east of Fort Widley.

Purbrook is also part of the Peter Ashley Trust and as well as on-site activities, it houses accommodation for visiting groups. As the most easterly of the Portsdown forts, it had an extra role and there used to be two redoubts – Crookhorn and Farlington (enclosed emplacements outside the main fort). These were linked by tunnel to Fort Purbrook but sadly the redoubts and most evidence of the tunnels has now gone.

The group at Fort Purbrook listening to the introduction to the site by our guide Maurice from the Palmerston Forts Society. Photo Chris Howells

An interesting use of the Fort in World War II was as the control centre for the Decoy Q or *Starfish* site on Hayling Island and Langstone Harbour. *Starfish* sites were set up close to likely targets for German bombing raids (including airfields, cities and ports) but a few miles distant in unpopulated areas. The idea was that in the event of a bombing raid, fires would be lit to simulate the effect of the raid and following bombers would drop their loads on the decoy rather than the actual target site.

On at least one occasion the Naval Dockyard at Portsmouth was successfully saved by *Starfish* but the perspective of the residents of Hayling Island is not recorded! The *Starfish* control bunker is still in situ just to the west of Langstone Harbour on Farlington Marshes.



Surface plan of Fort Purbrook

Hayling Island still has a very recommended large heavy anti-aircraft gun site at Sinah Common with various support buildings and shelters that you can visit for yourself. A memorial sits nearby remembering the six crewmembers who died when the German air force bombed the site there rather than Portsmouth due to the *Starfish* decoy. Many more hundreds though were saved due to their sacrifice.

On the outside face of Purbrook two later embrasures could be seen which were installed so that field guns could be used from within the fort. Entering the fort proper, we could see where the castellations had been removed for the erection of a radar head. We then had a look at the surface barracks which now form part of the residential complex and have been well restored.

They would have included barrack accommodation, canteen, Officers' Mess and so on. The original accommodation would have housed the fort's complement of 227 personnel. The buildings enclose a courtyard area which has white paint to the lower walls, funnelling soldiers to the entrance in blackout conditions.

Going Down

Descending once more we entered the tunnel level and began to explore below. As at Widley, the Fort had numerous tunnels, gun emplacements and caponiers for us to explore, and a fantastic spiral staircase with a 'Piccadilly Circus' of tunnels leading off it. What was very interesting was that some of the areas had been reused during WWII. Rooms had been 'upgraded' for accommodation as well as a telephone exchange for serving troops. There was even a newly-built toilet just for the WRNS to use! The gents' was outside…

We were shown the newly-discovered start of a tunnel to what would have been the nearby Crookhorn Redoubt. The tunnel is blocked but we could just see through the gap. The site owners are still working with English Heritage with regards to investigating the tunnel further. As the site is listed, they need permission before they can proceed any further.

SubBrit members walking down one of the tunnels at Fort Purbrook

Into the Moat

We then emerged into fresh air through what looked like a WWII door into the moat. It had probably been cut as an emergency exit rather than a modern-day sally port. Here we could see the enormous scale of the ditch and the withering fire it could have come under.

Metal shutters still in position at Fort Purbrook. These would have been lowered during an attack on the fort to enable the larger guns to fire down the length of the moat

There seemed literally to be no hiding place and it would have formed a killing field if enemies had gained it. Many of the musket gun ports were covered with iron doors which are believed to have been an experimental design. It was reasonably short-lived as an open port presumably indicated to attackers which positions were manned and worth a pop at.

Another mysterious feature in the moat was a further, crudely built, blind tunnel. In the north face an entrance has been cut through the four-foot-wide counterscarp brickwork and for perhaps fifteen feet beyond.

Theories about its purpose vary from a practice countermine header from World War I to a store dating from when the ditch was used as a rifle range in World War II. There is some correspondence that suggests it was built as an observation post by the 65th Chemical Warfare Company sometime after 1940. Just a slit was left for viewing purposes but how entry would be gained to a blind tunnel is puzzling to say the least.

Climbing up the wall

Finally we re-entered the tunnel system and found the original magazine area off the central junction. Here we came across one of the more bizarre reuses for an ammunition store. The two spaces (one originally for shells and the other for cartridges) are now home to two climbing walls. One is the more usual concrete wall with hand and foot holds and the other (the boulder room) has a replica cliff side including overhangs, cracks and chimneys. Both magazines are floored with soft cushioning in case a climber falls.

Tunnel leading from the barracks at Fort Purbrook

Both magazines at Fort Purbrook now hold climbing walls: one of the more striking and unusual re-uses of an ammunition store! Photographer Chris Rayner

Some attendees had time for a surface walk on top of the fort where a number of muzzle-loaded old guns were still in the emplacements. There were also some semi-sunken 'ready stores' for ammunition. The top of the spiral staircase was also visible in the middle of the former parade ground.

Although the Portsdown Forts were never used for their original purpose, they were put to a number of vital uses in the twentieth century. And now in the twenty-first they have found yet another lease of life providing leisure opportunities to all.

Thanks are due to Mark Russell for arranging the visit. It is hoped to arrange repeat visits during 2017 for other Sub Brit members.

Photos by Mark Russell unless stated

Foot tunnel at Cliviger, near Burnley, Lancs

Ken Geddes

Inside the subway looking northeast towards Holme Hall

An unusual story emerged on a recent walk up to the Thieveley Lead Mines in Cliviger Gorge. We parked in the car park of *The Ram Inn* and walked east, turning south at a public footpath sign along a rather superior trackway towards the railway, across the valley, almost opposite Holme Hall, a listed building.

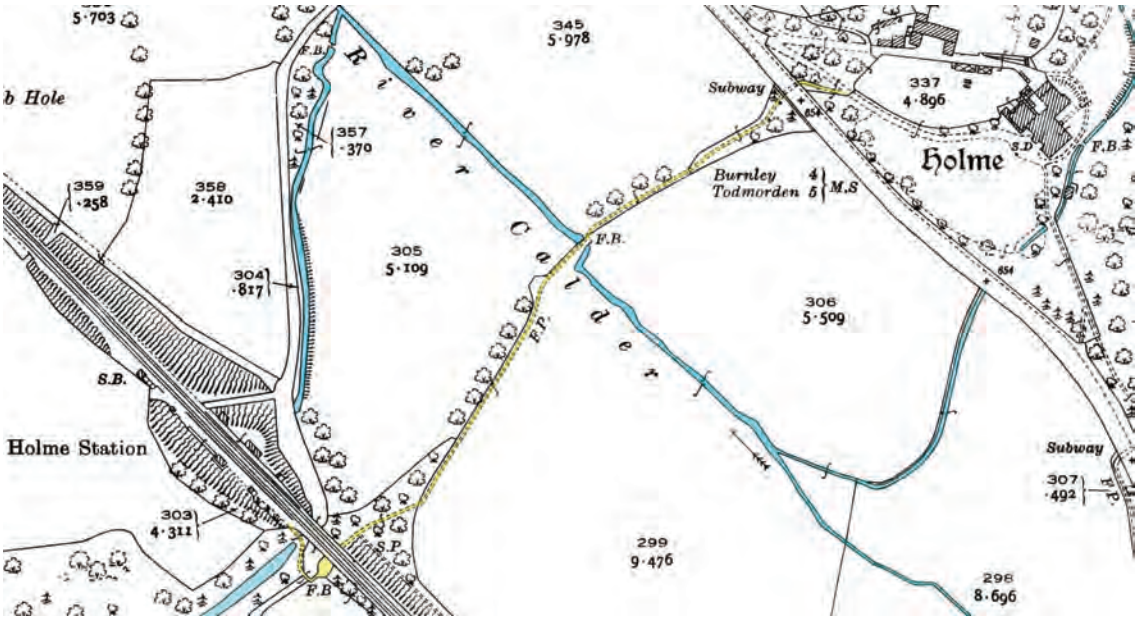
The railway is the "Copy Pit" line between Todmorden and Burnley, which climbs steeply up the valley to Copy Pit and then on to Burnley. It was named after a coal mine of the same name, the remains of which we explored on an earlier walk.

An unexpected feature on the left immediately over the stile was a cutting leading to the mouth of a foot tunnel crossing under the road and heading towards Holme Hall. The approach to and the tunnel itself were in excellent condition, although clearly not used and full of last autumn's leaves.

Holme Hall is a Grade II* listed building, going back to 1340 when Richard de Whitacre arrived from Upper

Southwest approach to the subway

Whiteacre (now Padiham). The stone building of eventually 40 rooms was converted from a wooden structure in stages from 1431 to 1717, with a further rear



The path from the Holme House (top right) starts westerly, then forks left through the tunnel ('Subway') and continues southwest across the map to pass under the railway. It then turns right over a private bridge, bearing right to reach the Burnley direction platform of Holme Station. It's marked as a footpath all the way and is shown in yellow

extension in 1854. Between 1985 and early 2003 it was a retirement home but was closed to be sold.

In March that year it was devastated by an arson attack which destroyed all but the west wing and the 1854 rear extension. In 2007 it received planning permission for conversion into apartments on the condition that the exterior should be restored. After a saga of a sale, a bankruptcy and an expiry of planning permission, it has now been converted with superb external restoration. What was lost can only be speculated, but two of the original set of eighteen carved yew chairs were valued by the *Antiques Roadshow* in 2014 as worth between £2,000 and £4,000.

The north entrance to the subway showing 90 degree turn from the approach path to the tunnel itself

The tunnel might have been a way to the servants' quarters, but it surfaces some way short of the house. The true purpose was to provide an easy route to Holme railway station which was opened on 12 November 1849, along with the Copy Pit line itself. It was possibly constructed at the same time as the hall's rear extension.

Although the road from Todmorden to Burnley had been turnpiked since about 1759, the railway in the mid-1800s must have been a godsend in an area which was so wild that it was said that some of the purchase deeds of the railway had to be made out to totally illiterate farmers in favour of their nicknames, such as "Jack o'Tops".

The Whitakers however had a problem. They wanted to avoid mixing with locals and also be discreet. So no horse and carriages! Just a walk through the tunnel, across their field and then over their private footbridge which connected directly with the platform for Burnley.

There is a local belief that they chartered a complete railway carriage which stopped at a section of segregated platform which was accessed by the bridge, but so far I have found no written evidence.

Colour photos by Ken Geddes

Train and staff at Holme Station c1905. Photo from John Alsop collection

Reach for the Sky

Martin Dixon

The Sub Brit team with Ben Begley (third left) outside the Wartling emergency exit. Photo Adrian Armishaw

It is not unusual for Subterranea Britannica to be approached by the media, often looking for filming locations or for 'secret' underground structures to feature in documentaries. We always try and respond to these, even though on occasion it might appear we are doing the enquirer's job for them in helping put together a pitch to broadcasters.

Scouting for sites

It was a welcome change to be approached by Ben Begley of *Sky News* in July of this year to be asked to take part in a news item about Sub Brit. Having got the Committee's OK, we originally hoped to be able to film on the visit Chris Rayner arranged to the 'Scout' chalk mine in Reading. However, after consideration, the site owners didn't want the visit to be filmed (and the 60-foot ladder pitch would have added complications) so we looked for another location.

Our next suggestion was the Rotor GCI (Ground Controlled Intercept) radar bunker at former RAF Wartling. It has a terrific atmosphere, and many Sub Brit members have worked as volunteers with John Smiles to preserve the bunker through waterproofing and other remedial work. We first had to get the site owner's permission which was generously given – provided nothing in the broadcast described the site's location beyond the enigmatic 'somewhere in southern England'. Like many such owners, their concern was that flagging the location would encourage unauthorised entry attempts.

Cattle on the road, Sir

Sky wanted to film on a weekday which reduced the pool of members who could attend but on a gloriously sunny day in August five of us rendezvoused on site and waited for Ben. His arrival was slightly delayed as he had to negotiate the local herd of cows being taken for afternoon milking – adding a slightly Dad's Army dimension to the start of the visit.

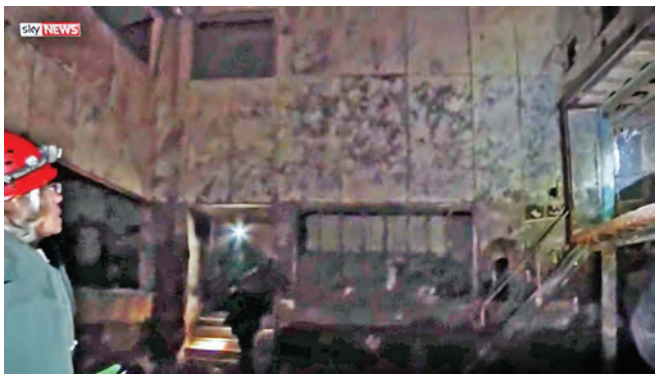
Since talking to his boss, it appeared that the news item would now focus on urban exploration and its perils, with Sub Brit as a contrast, showing our more structured and strictly legal approach. Not quite what we expected when we agreed to contribute but, as they say, all publicity is good publicity.

Having kitted us all up in boiler suits, Howard Rackliff led a tour of the bunker. Even though we all knew the site well, it gave Ben the opportunity to film the entire site with a background commentary that he could cut into the final piece. Personally I hadn't been in the bunker since

the most recent remedial work (partly funded by Sub Brit), and was hugely impressed by the results achieved by John Smiles and the team. More details of this work are in *Subterranea* 40 (December 2015), page 83.

Grate expectations

Many of the walkways now have new metal gratings to replace the previously rotted floors and an electricity supply has been installed which greatly helps with ongoing works. Perhaps most impressively, two major installations now keep the bunker virtually (in Sub Brit terms) dry. The dam in the former cable shaft now leads to a holding tank from where a float-operated pump automatically empties water onto the surface.



The impressive two-level Operations Room at RAF Wartling. One of the few such Rotor structures to survive, viewing windows can be seen centre and left on both ground and first floors. To the right would have stood the tote boards, accessed from the well via the staircase bottom right

In addition a bilge pump has been installed in the sump in the machine room which ingeniously feeds into the original sewer-ejector pipes and hence to the surface near the former sewage works. It's terrific that Sub Brit has amongst its members experts in many fields who use their expertise in this way.

Ben was amazed to see what lay beneath such a rural landscape and the original two-storey Operations Room was undoubtedly the highlight. The team has cleared away most of the debris that previously covered the floor making it easier to visualise the site in use. So many Rotor sites were reused later in the Cold War and most of their Ops Rooms were floored over and the plotting room and balconies lost.

We were all intrigued to hear that Howard's parents had actually met underground at Wartling while serving in the RAF and WRAF. There can't be many people who can confidently visit the site of their parents' first meeting. Despite the fact that Ben had talked to a number of urban explorers, he hadn't been able to visit any underground sites previously as Sky wouldn't endorse entering property without permission, even for a news item.

Question and Answer

Having filmed our tour, Ben then interviewed us all separately at different locations around the bunker. The backdrops included the canteen, main corridor and stairway and the questions centred around what drove our fascination with underground structures. Of course, as often happens, most of the material ended up on the cutting-room floor but our passion for the recording and preservation of sites – and the great teamwork that supports this – was very clear.

Having finished filming, we retraced our steps and secured the site. As the sun was approaching the yard-arm we retired to *The Lamb* in Wartling village for a pint of Harvey's and a debrief. It was interesting to see that Sky used one staff-member and a tiny camera to film and record the whole piece whereas fifty years ago a sizeable crew and outside-broadcast van would probably have turned up. Not unlike the changes and down-sizing in radar technology, with today's smartphone apps being able to track individual planes and deliver their precise details to any interested bystander.

Sub Brit Chairman being interviewed for the Sky News item in the main upper corridor in the Wartling Rotor Bunker

Broadcast

The news item was broadcast on Sunday 28 August – repeated on an hourly basis. Despite the condensing of an afternoon's filming into a couple of minutes, the piece got the message across that it is quite possible to explore most underground sites with the owner's permission. As I said on the day, "Although I can understand the 'thrill of the chase' that drives much urban exploration, members of Subterranea Britannica are focused on the quarry (pun intended) rather than the chase."

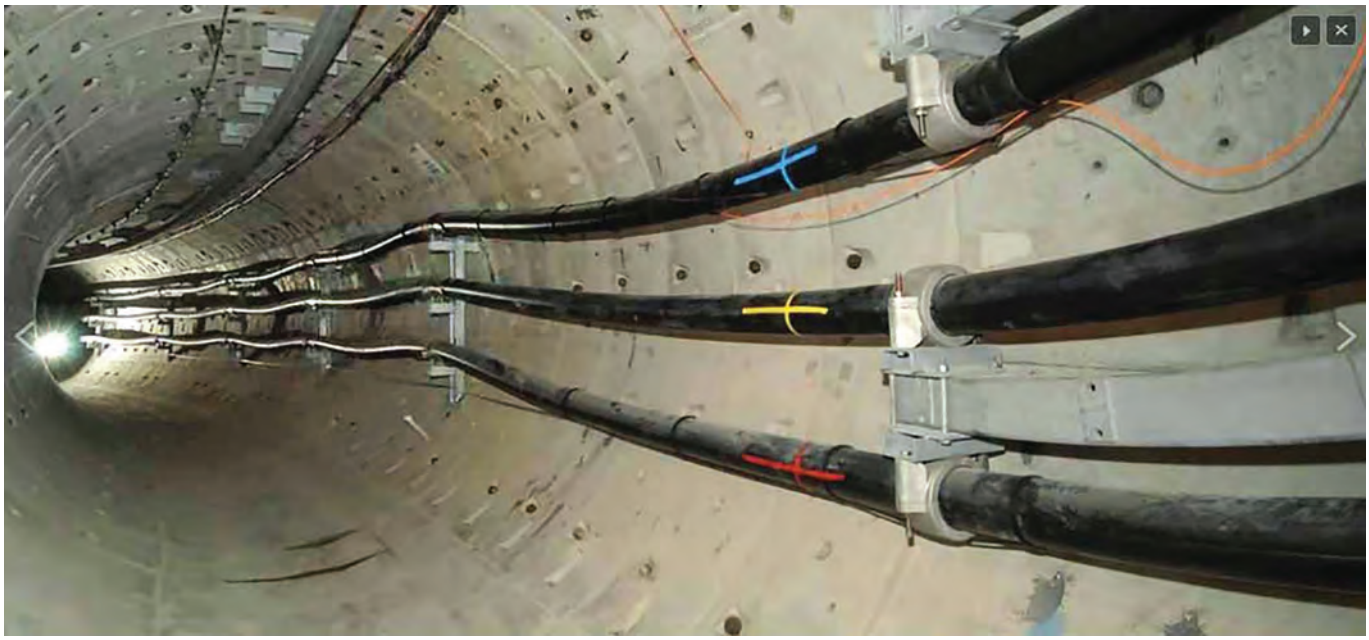
On the day of the broadcast, activity on our public website was double that of normal traffic and we also gained a few new members who had seen the broadcast and liked what they saw. Linda and I were contacted by a number of friends – one whom we hadn't seen for years saying that they had seen the broadcast and were pleased to see we were still alive and kicking!

Thanks are due to David Harding for agreeing access and to members Linda Dixon, Howard Rackliff, Jason Hughes and Adrian Armishaw for giving up their time to be filmed. For details of the bunker, see the SB website. At the time of writing, the broadcast and accompanying article were still available at:

http://news.sky.com/story/urbex-daredevils-court-sponsorship-and-death-with-risky-stunts-10554384

North London's private monorail tunnel

Ian Mansfield



The monorail tracks run along the top of the tunnel

Surprise. Under north London, there exists a private underground monorail service, some 20km long running from Elstree to St John's Wood, almost in the centre of town.

You can't ride on the monorail, and it's not an escape route for Royals or rich oligarchs, it's actually owned by the electricity grid – and it's their inspection railway. Completed in November 2005, the deep-level tunnel, some 25 metres below ground, connects a new 400kV substation at St. John's Wood to its counterpart in Elstree and was needed to meet London's ever-growing demand for power.

This 20km-long tunnel contains one of the longest 400kV XLPE cable circuits to be installed in Europe. At present the tunnel only contains one cable circuit, but has the facility to have a second installed in the future.

Boring but necessary

Construction of the three-metre-wide tunnel took place from April 2001 to March 2004. To put the size into context, a typical London tube tunnel is only slightly wider, at 3.5 metres in width.

Fata Automation monorail

The tunnel was constructed utilising three tunnel-boring machines (TBMs) working from two drive shafts. From the Elstree drive shaft the tunnel was driven south to Canons Corner (5.6km). Initially the strata encountered were sand and gravel; however this gradually changed to London Clay as the tunnel deepens towards shaft two.

At Cricklewood, the tunnel was driven in both directions, northwards to connect at Canons Corner (8.2km) and southwards to St John's Wood (6km). The tunnel in this section was constructed wholly in London Clay using an expanded lining. Access shafts were either 7.5m or 10.5m in diameter and up to 42m deep – all sunk by underpinning methods.

But, when you have a 20km-long tunnel, how do you inspect it? Walking wouldn't be the ideal solution, due to the length of the tunnel; in any case the close proximity of the electricity cables rules it out for safety reasons. Instead an unmanned battery-powered monorail was installed.

Current Technology

Supplied by Fata Automation, the monorail network supports four remote-controlled cable inspection vehicles. The vehicles are designed to inspect the National Grid cables within the tunnel using infrared cameras fitted to the vehicles.

The vehicles are controlled remotely from control desks fitted with television monitors which allow the operators to control the vehicles and view the condition of the cables. The devices hang down from monorail tracks that run along the top of the tunnel.

The end of the tunnel

The vehicles, with an attached trailer, travel at speeds of up to 2.5 metres/second (9km per hour). When necessary, they are also capable of carrying up to five personnel and 500kg of tools for maintenance or evacuation purposes.

Editor's note: Those on the Prague study weekend in May 2014 will recall travelling on a battery train through the city's 'Kolektory' (service tunnels) where they encountered electricity, gas, water, telephone and data services all routed in a 90-kilometre network under the city.

Oh, that London authorities were as generous in allowing access to their subterranean gems.

Sources:

National Grid press release
Fata Automation

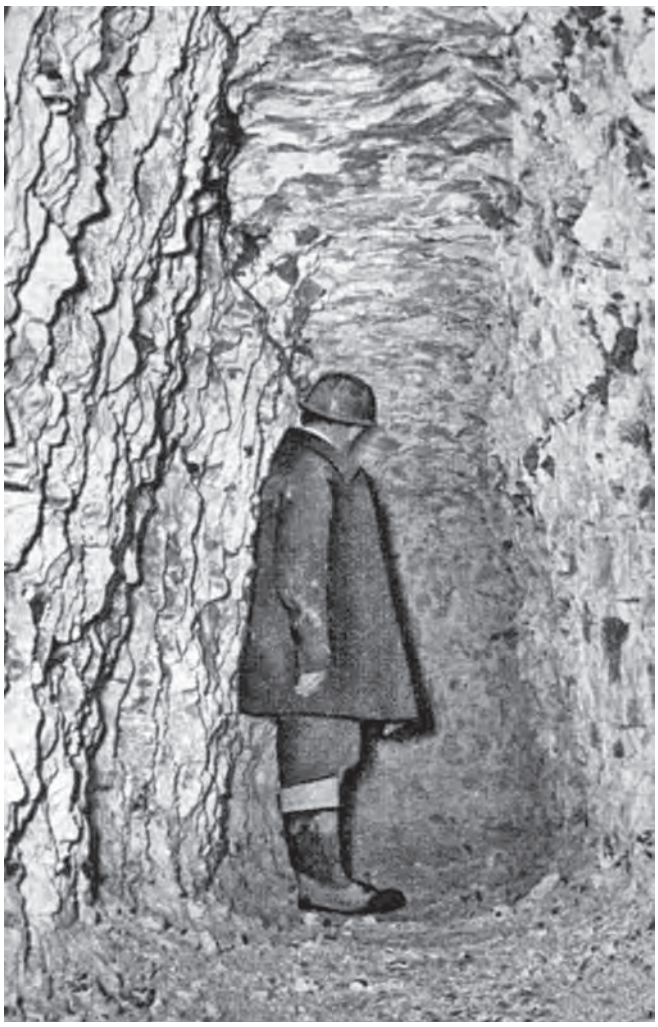
Chalk mine underneath Plumstead bus garage, SE London

London Transport's staff magazine for March 1958 contained a short article describing the routine inspection of chalk mine tunnels below Plumstead bus garage.

The text of the article reads as follows …

> Down the ladders of a dank shaft and into the eerie workings of a disused chalk mine went our somewhat apprehensive reporter. Dim electric light bulbs and the narrow beam of a hand lamp showed the way into a darkened gallery.
>
> It was an unusual expedition. Sixty feet above was Plumstead bus garage, with the buses coming and going as usual. Though new to our reporter, this inspection was a routine affair for the three men in his company.
>
> He was there to see the out-of-the-ordinary job which our civil engineers have been tackling for the past year. They are trying to trace and fill in a maze of chalk tunnels beneath the garage.
>
> Before the days of lorries, chalk for building was actually mined like coal, instead of [opencast] quarried. But at the turn of the century easier transport made mining uneconomic at Plumstead, and the workings were abandoned.
>
> There have been serious subsidences in the vicinity over a long period, and five years ago London County Council, realising the danger of the mines, began finding and filling in the cavities. Last year their excavators discovered galleries leading under Plumstead garage and our engineers were called in.
>
> Bore holes have been made in various places to test the solidity of the ground and several shafts have been sunk in and around the garage. Sixty feet below ground a heading, about 250 feet long, has been bored, and this gives access to two old galleries. One cavern our men stumbled upon was large enough to take a bus!
>
> Several of the cavities have now been filled in. A mixture of pulverised fuel dust and water is pumped down and this eventually sets like cement.

The article is accompanied by a photograph captioned 'Sixty feet below Plumstead garage Charles Marshall, of the chief civil engineer's department, inspects a tunnel in the chalk'. Marshall is shown standing in a trapezoidal-section tunnel rather over a metre wide at the floor level, and two metres high: this is presumably the then modern access tunnel.



Sixty feet below Plumstead garage Charles Marshall of the Chief Civil Engineer's department inspects a tunnel in the chalk

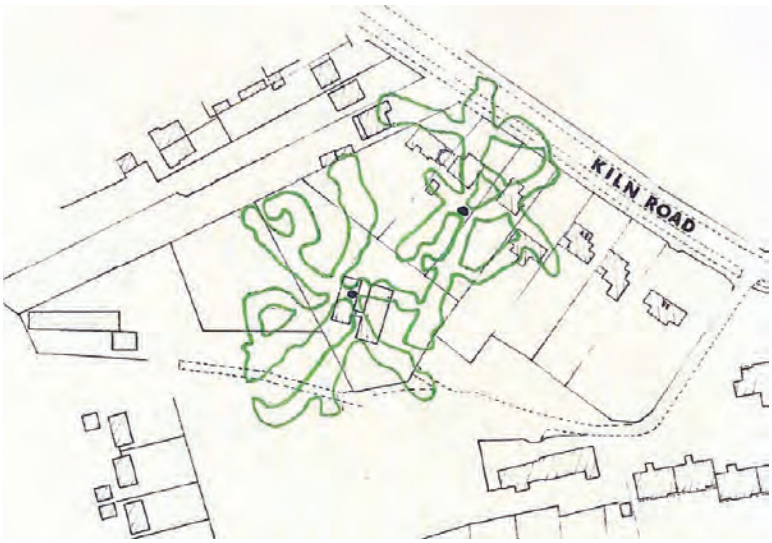
The former garage, now replaced by modern commercial premises, stood at the junction of Wickham Lane and the King's Highway, to the south of Plumstead High Street. The site is immediately north of Alliance Road, where houses had previously collapsed into an old chalk mine. SOURCE: LONDON TRANSPORT, 1958, Caves under a garage. *London Transport Magazine* 11(12), March 1958, page 9.

Sub Brit Visit to Scout Mine, near Reading

Chris Rayner

Chalk mine main roadway outside the Council repository, the brick outer wall of which can be seen to be set back from the main mine wall

On a warm Saturday morning at the end of July 2016 a small group of Sub Brit members met at a Scout Hut near Reading, west of London. On this occasion we weren't here to make camp fires and practise knots and first-aid but, better still, to descend a 70ft (21m) shaft to an old underground chalk mine.



SubBrit members gathering at the base of the access ladder

The mine is the more recent counterpart to the adjacent Hanover Mine recorded on the SubBrit website www.subbrit.org.uk/sb-sites/sites/h/hanover_chalk_mine/index.shtml . Paul Sowan has given a very comprehensive account here of the local geology and of the history of brickmaking in the area, which of course also holds true for this mine and is recommended as background reading.

Bricks and Mortar

Chalk was a valuable commodity in the late Middle Ages and into the early modern period. It was a vital component in brickmaking, added to the brick clay as an aqueous slurry to reduce brick shrinkage during firing. Meanwhile, when burned in a lime kiln it would become quicklime (calcium oxide), which when mixed with water would create slaked lime (calcium hydroxide), used to make lime putty for mortar and plaster manufacture.

It was also used as a marling dressing to break up heavy clay soils, for road making (in pre-tarmacadam times), and we haven't even considered the flint seams found in the chalk, which would have been used as a building material.

In Reading, the Cretaceous-era chalk is overlain by more recent clays, hence the deep shaft down which we were about to descend. To speed up descents and therefore time within the mine, we were roped down in a controlled abseil once we had harnessed up, but even though this was a much quicker process than waiting for us each to descend the fixed ladder, it still meant that we needed to break into two smaller groups to go round the mine.

A brick wall separates the mine from the Council repository, while one of the steel sheeted secure enclosures is seen through the door. In front of the wall a chalk roof overhang is propped with more conventional timber mine props. Also visible are exposed steel reinforcement above the concrete door lintel and a large diameter pipe hole, both unusual features whose function is unknown

Looking from the main repository chamber towards its entrance brick screen. The peculiar large diameter pipe passing through the wall resembles the large sewer pipes used in Stockport's Chestergate shelter, but the function here is likely to have been for ventilation

On plan, chalk mines look very organic as they curve and branch in an apparently random fashion. Very little in mining is random however, and the plan form is likely to have been a function of productive seams, awareness of faults, and rules-of-thumb on structural support.

One is rarely aware of this as the abiding impression is of galleries of great height, typically of the order of five metres, and with an arched cross-sectional shape. The height comes about through excavation of the tunnel floor, and thus in a chalk mine the worked wall surface becomes progressively younger the lower down the wall one looks. The passages are also quite wide, often of the order of four metres.

Underground Reading Room

A museum of finds in one section of the mine includes some items from its mining past. Unlike the Hanover Mine however, the Scout Mine saw reuse during the Second World War, after mining operations had effectively ended. Reading Council chose it to act as their archives repository, reasoning that its 70ft depth would protect it from even the heaviest bombs known of at that time.

Only one arm appears to have been used for this purpose, the far end of which was fitted with two corrugated-steel vaulted chambers set behind a vertical steel sheeted wall. These chambers are reminiscent both in profile and construction of the Dover deep shelters and other wartime structures built by the Royal Engineers, having a similar width and vaulted steel ribs and cladding rails. They are however very much shorter and the sheet corrugations are different, confirming a very different procurement history.

Some sheets have stencilled instructions, "Left" and "Right" on them which could indicate that the sheets were made to measure offsite. They have not corroded greatly, suggesting that the sheeting was of a high quality

Main repository chamber with the remains of rotten tea chests used to store records in, and with the two vaulted secure stores at the rear

and heavily galvanised, installed at an early stage of the war, or even prewar, before zinc was in very short supply.

Treasure chests

The front section of the repository has the remains of rotted tea chests, on one of which the name Jatinangor, a tea producing area of Java, is stencilled. Meanwhile the whole repository is protected and secured from the remainder of the mine by an English-bond brick wall with a doorway and a peculiar embedded large section salt-glazed pipe that may have accommodated ventilation pipework.

It is unclear how the repository was used – what for example would have been stored in the arch-roofed metal shelters at the far end? Presumably they were used for the most secure records. Within the larger outer chamber, an early 1930s tram timetable is the only evidence of what might have been stored in the tea chests. One imagines it being discarded as worthless when the repository treasures were returned to the surface after the war.

All the same, one wonders why the Council officials tasked with securing their records at the start of the war thought an out-of-date tram timetable was worthy of preservation. The duct in the brick wall is also intriguing, suggesting some form of mechanical ventilation, although the absence of ductwork in the rest of the mine seems to argue against this.

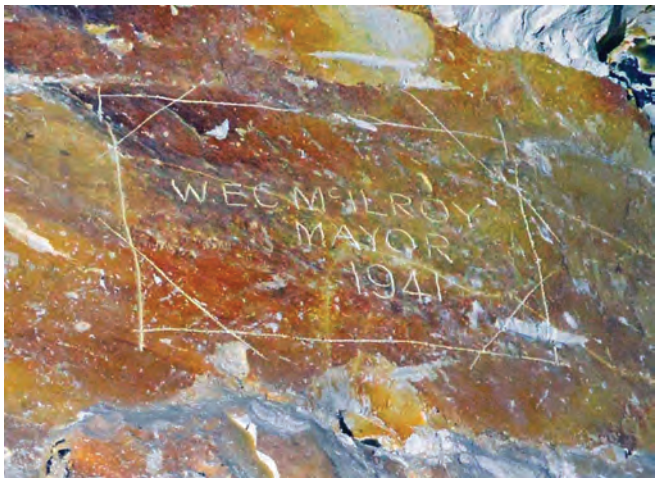
Inside one of the secure stores and looking out to the main repository chamber. The construction method is very similar to the Royal Engineers-built gun shelters of Dover and elsewhere

Auxiliary Unit hide?

The mine appears to have been tidied up and made more easily accessible in its preparation for wartime use, and level pathways have been formed between many of the chambers as part of this. Walking around the mine, there was none of the usual stumbling one might be prone to while exploring round an abandoned chalk mine and gazing up at the ceiling (which, of course, no one in Sub Brit would do!).

There are also remains of electric fixings for phone and power cables which may have been to facilitate access to the repository, or in connection with the mine's reputed use as an Auxiliary Unit hide, for use by a local resistance team in the event of a German invasion.

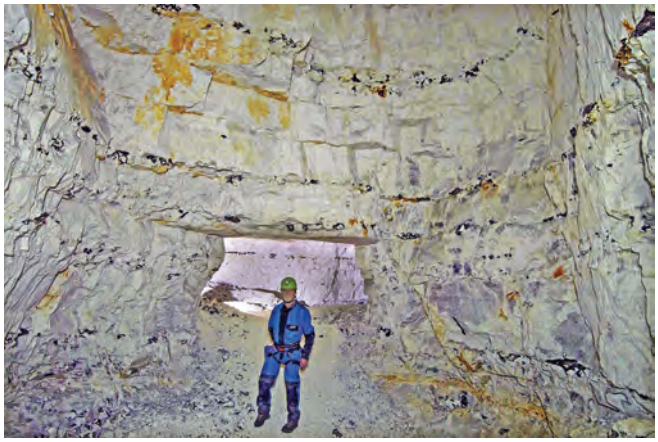
Remains of a copy of the *Manchester Guardian* from March 1942 are evidence of occasional wartime visits, possibly to the repository, as is a distinguished piece of etched graffiti by the Town Mayor, from 1941. There are also other graffiti in the mine from the wartime period or earlier mining periods.



The Mayor leaves his mark during a wartime visit to view the Council record stores

No bats were seen during the visit, although the mine is known to be used as a winter hibernation roost by at least three species of bats (Natterer's, Daubenton's and Brown Long-eared), although only ten or so individuals have been seen hiding in some of the many cracks and crevices in the chalk during annual visits by bat surveyors.

The time passed all too quickly and it was soon time to climb the long vertical ladder to the surface. It was a tremendous visit and we were all sorry for it to end. A second Sub Brit visit is planned for March 2017.



SubBrit member Richard West stands in front of a small opening (the lower portion of which has since filled with debris) to an adjacent chamber

In the meantime, our thanks to the Scout Group and in particular John Potter during the preparation work, and Colin, Alex, Rusty, Steven and Robin on the day.

All photos Chris Rayner

Kenton Bar Fighter Command Bunker – an update

Colin Anderson (Bunker 13 Ltd)

The new floor in the plotting room is nearing completion. Photo Colin Anderson

A group was set up around eight years ago to try and open up the former RAF Fighter Command bunker at Kenton Bar in Newcastle-upon-Tyne to the public. The group is called Bunker 13, a reference to the fact that the headquarters was for 13 Group.

Following the appearance of the Bunker on BBC local news (*Look North*) in November 2015, Bunker 13 got a lot of useful contacts from interested members of the public via email and Facebook. There followed a meeting with those who could attend, and two visits to the bunker on consecutive Sundays to let them see the current state of the building.

Flood damage

Currently, the four directors of Bunker 13 Ltd are still able to access the bunker and are working hard to remove the after-effects of the flood in 2011 which caused much of the damage visible in recent pictures of the interior.

The communication room has been cleared of rubbish and dried out. In the middle of the room a service lift goes up to the AOC office above. Photo Colin Anderson

Fortunately it was nice clean ground water which had accumulated in the void under the back stairs and seeped through the concrete. We now have very little water left except for a rather large amount

of (very) damp rubble under the recently refitted plotting room floor.

We have three access holes that were cut into the floor when the bunker was originally pumped out by contractors working for Taylor Wimpey. We have used these to clear rubble by hand and have used a wet and dry vacuum cleaner to remove as much water as possible. Leaving up to a week between sessions allows more water to seep out of the rest of the rubble. Ideally we'd like to get the whole floor up and remove the rubble – but we don't know what's in the rubble (asbestos?) and we don't own the building, so we're stuck on this one at the moment.

The other large body of water was in the sewage ejector sump. This was dealt with by using three submersible pumps and break tanks to get it up the back stairs and out of the bunker. There remains some sludge in there which is being dug out, filtered, dried out and disposed of – a slow process. This residue is mostly sand from sandbags that were left in the bunker and had rotted, and linoleum from floors in the lower rooms. We also have three dehumidifiers running 24/7 and these drain into the pump / breaktank system.

Future plans

The aims of Bunker 13 Ltd are to preserve the bunker as a first step and once ownership and lease issues are sorted, apply for funding to open the bunker as an educational resource for local and other schools to visit on a strictly controlled basis.

The controllers cabins overlooking the plotting room. This picture dates from the 1980s. Although the bunker was designated by the Home Office as War HQ for the new Tyne and Wear County Council in 1974 ilk was never fitted out. Photo from Sub Brit collection

The bunker is in the middle of a new housing estate and maintaining good relations with the residents is essential. Currently we are working on upgrading the Grade II listing to Grade II* and we are going to change our limited-by-guarantee company to a Charitable Incorporated Organisation (CIO) which should assist in attracting funding.

Further information:
www.subbrit.org.uk/rsg/sites/k/kenton_bar/index1.html

Urban myths in Croydon

Paul W. Sowan

I have been assured, in one public house or another in Croydon, that there is a 'secret government underground station' in Haling Road, South Croydon. My informant assured me he could hear the trains running back and forth in a tunnel under his flat. He had no suggestions concerning the location of the line's termini or any intermediate stations!

Inspection of the site reveals an anonymous bunker-like windowless building and substantial car park well screened behind a thick and substantial hedge and with seriously padlocked steel gates. By peering through the hedge at one point it is possible to read that the premises (50–58 Haling Road) are in fact a meeting hall of the Brethren.

This bunker-like building (no part of which, I am sure, is below ground level) is currently for sale, and proposed for redevelopment as a new primary school. Presumably, if that scheme goes ahead, it will be provided with windows, if not demolished and replaced by a more suitable structure.

Further south, in Godstone Road (Kenley), the WWII deep air-raid shelter in chalk tunnels under the City of London's Riddlesdown public open space has been credited with a secret tunnel link to the Riddlesdown railway tunnel (836 yards) which runs a quarter or a mile or so further to the east. From personal inspection, no such tunnel exists!

It has also been claimed that during the Cold War these tunnels were used to store papier-mâché coffins for mass burials (but it seems no grave-digging tools, which might have been a good idea). However, Harry Pearman's description of this site as he found it before Optical Surfaces Ltd took it over (see *Subterranea* 19, May 2009) mentions that the tunnels had been used briefly after the war for mushroom culture, but contained no coffins! When Optical Surfaces Ltd staff moved in, it took them several days to clear a way through vegetation to reach the entrance.

The WWII Super Zero Station at Wilton, near Salisbury

Brian Drury

Looking towards the main entrance. Bunks are seen left and right.
The entrance blast-proof door is to the left through the opening. Photo Chris Warren

The Auxiliary Units were formed in World War II to 'go to ground' after a possible invasion and form up as patrols that would wreak havoc behind enemy lines. A second branch, known as 'Special Duties', was later formed and consisted of spies who would continue their normal life but feed intelligence reports through a secret radio network.

These messages were received at an underground receiving station, known as a Zero Station (from the code used during transmission). Unlike the patrols, both men and women were part of the Special Duties section.

Subterranea 34 (December 2013) carried an article by Evelyn Simak describing a Zero Station near Halstead in Essex. The piece provided a general description of the wireless network to which the station was connected and that network included a larger Zero station at Wilton in Wiltshire which is known as a Super Zero Station. There is some dispute over the origin of the name Zero station, with some researchers believing it to have evolved after WWII; however, the author believes it is the original term that was used.

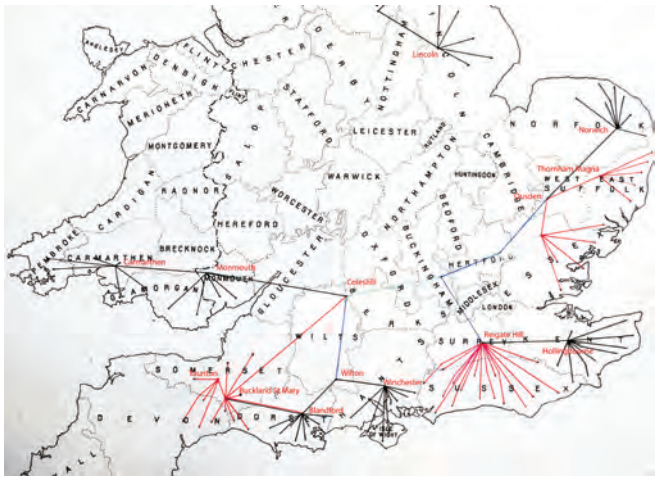
Network Map

The existence of a station somewhere in the Salisbury area became public knowledge when a network communications map was unearthed at The National Archives (TNA). The map is located within TNA document bundle WO/199/1194

TNA positively encourage visitors to photograph documents but the original paper map is too large for a single camera image. This picture (overleaf) was created by joining two photos using Photoshop. The horizontal and vertical lines are where the original was folded allowing it to fit inside the document bundle.

The map is signed by Major R.M.A. Jones as corrected to June 1944. Major Jones was the officer commanding Auxiliary Units Signals when it was closed down in September 1944. The author has annotated the smaller maps to indicate station locations where known. The link colour denotes operating frequency. Blue is 52 MHz, black is 60 MHz and red is 65MHz. The VHF aerials were

Major R.M.A. Jones' Complete Network Map



Southern part of the Map

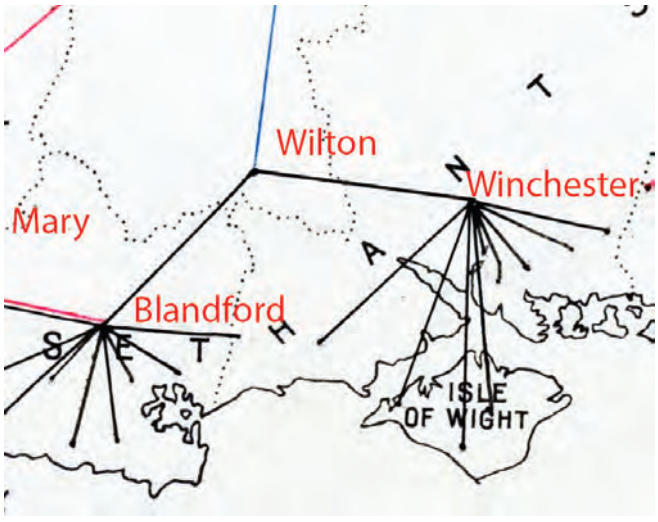
horizontally polarised therefore three separate aerials and feeders were required to support three communication links.

The map portrays the hierarchical nature of the Special Duties (SD) network. In-Stations such as Blandford and Winchester communicated directly with their local outstations and the information received was passed up the chain to the inner network via Wilton. For several years the author and others have diligently researched the subject of the Special Duties branch of the Auxiliary Units.

Some information was provided by the National Archives but one item of particular interest was a diary maintained by Beatrice Temple. Beatrice was the Senior Commander of ATS Special Duties personnel. The young women that she was responsible for were trained to operate a sophisticated nationwide covert VHF wireless network that was to be used before, during and after the anticipated invasion by German armed forces.

Beatrice maintained the diary from 1941 to 1944 where she recorded visits to her girls in their stations throughout the UK. After several false leads the diary was traced back to the Temple family where it was discovered that the apparently worthless item was discarded during a house move.

During an interview by the author with Barbara Culleton (ATS officer) it was revealed that she had made a copy of the diary and annotated it with her own thoughts and comments. Barbara had given the copy to another researcher for general distribution so in due course an electronic copy was received for inspection. It was very encouraging to read that Beatrice had herself visited the Salisbury dugout and the term 'Super Zero' was encountered for the first time.



Map section around Salisbury

Although Barbara has added her own comments and interpretations in the diary notes it is most unlikely that she coined the term of 'Super'; during another interview with the author she claimed to have only ever entered one dugout. In fact she says the Zero Station dugouts were not introduced until after her field support role was finished. Also, she claimed to have no knowledge of any station at Wilton.

Diary Entries

Beatrice Temple was driven by Price to Salisbury where Mr Gardiner (or Gartner) shows her the new Super Zero station. The diary provides a new clue to the existence of an underground communication centre somewhere near Salisbury. The relevant diary entry is:

Nov 15th 1943

To Shaftesbury (Price driving) – hospital case. and then Salisbury for stationery supplies. Visited Hut - shown the super zero by Mr Gartner. On to Barrack Officer – very helpful. Then to Ann? About changing her mind. – Mickie to come as Store Officer. Had letter from the Commander. Price lost way. HH at 21.00.

Mr Gartner/Gardiner has not been identified. Ann was probably Ann Ellis-Hughes who was stationed in the above ground site at Blandford for a while. Mickie is very likely to be Mickie Brown (née Trant). HH is Hannington Hall in Hannington village, Wiltshire; this was the administrative base and billet for senior ATS personnel.

The station at Wilton is the largest so far discovered and may be the biggest that was built although there could yet be something similar to be found on Reigate Hill in Surrey. Prior to becoming operational, Salisbury area communications were controlled by the station at Alderbury. This was an above ground hut rather than a dugout. Beatrice visited the Zero Station for an exercise. The exercise was joined by Major Jones who returned Beatrice to her hotel after dinner.

Feb 13th 1944

To Salisbury – visited zero – returned to Hut after dinner at 9pm – Exercise joined by Major Jones who returned me to Hotel. O/N [side note: Cpl Styan going to have a baby]

What is clear from research on this subject is that the network varied in detail during its period of operation. The only certainty is the network map that Major Jones has signed. How accurate the map was at the time is difficult to judge but so far many of the stations shown have been confirmed. In addition to the Major Jones map, a further clue to the Wilton location is a letter from Major Peter Forbes (Special Duties Major) to Arthur Gabbitas dated 1 Feb 1998 in which Peter says:

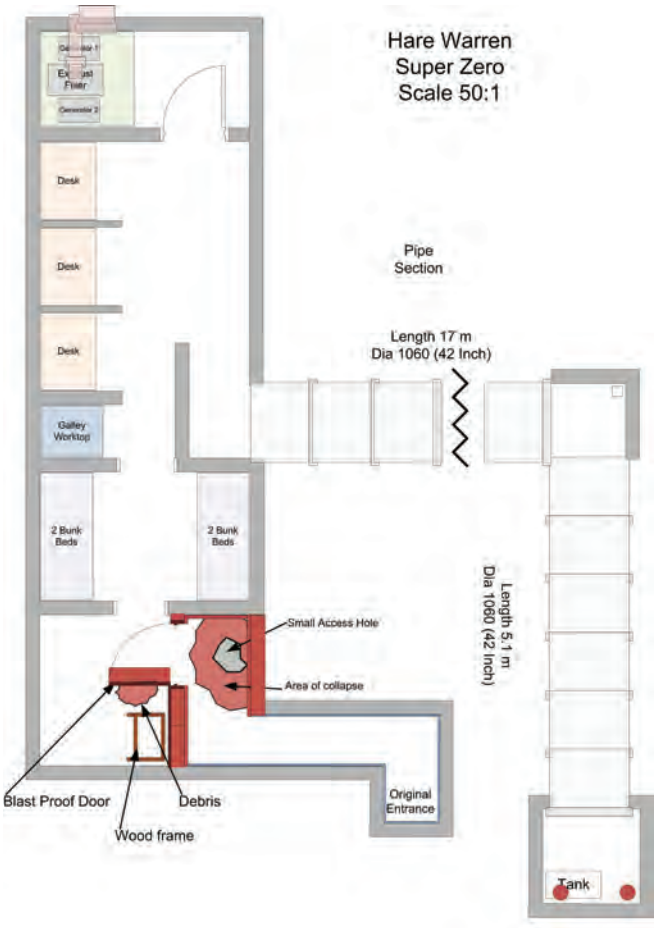
My job was to write exercises to test all the networks & then go round to see them carried out. In my 6 months I visited all the Zero stations etc but I cannot now remember where most were. I remember visiting Maj Fraser & staying at Sevenoaks & Canterbury. There was one, I think, in Wilton, Salisbury & one on top of Reigate Hill.

The Major Jones map was converted to a transparent GIF image and used as an overlay in Google Earth. The coastal outline was used to align the image and then the location of the stations was compared to known locations. In some cases the dot on the network map is remarkably close to the known location of the station.

However, in most cases the alignment is poor; there are several reasons for the map image to be inaccurate. To begin with there are the field measurement and cartographer's errors. Then there are photographic problems including the distortion produced by folds in the paper and the parallax error due to using a hand-held camera. Finally, the cylindrical projection used in Google Earth may not precisely match the projection used in Major Jones' coastal outline.

The dot for Wilton suggests the location to be about four miles east of Wilton. The dots to scale are as much as 1.5 miles across therefore a four-mile error is probably reasonable. After much searching, the Wilton Super Zero Station was eventually located in Hare Warren Woods. The site is of such historical importance that it was listed by Historic England and recorded photographically. A scale plan view drawing was also produced.

Station Layout



Entrance

Entry to the underground dugout was via a hatch and passageway leading to the entrance lobby. The substantial blast-proof door was constructed from railway sleepers lined on the inside with an earth-filled box made from

Inside view of the blast door

planks and battens. Soil can be seen within the door cavity in this photo.

This door was both camouflaged and fortified. It is not clear if the soil-filled compartment was designed to increase the effective density and prevent discovery by simply tapping the internal walls of the first chamber but it certainly has that effect. It seems that the small entry lobby was designed to appear as if the dugout finished at that point. Checking for further voids by banging the walls would not reveal the main part of the dugout.

Sleeping Bay

One side of the sleeping bay area. Photo Chris Warren

Four beds were provided. Battens for the upper bed can be seen but the horizontal pieces and mesh have gone. An elaborate ventilation system using salt-glazed ceramic pipes is provided in the sleeping area. This has not been seen in any of the smaller Zero Stations.

Wireless Bays

The wireless room is provided with three operator positions. Each has a separate aerial connection and the bays are enclosed with sound-absorbing material. Three bays suggest that up to three wireless links were operated

The three wireless bays. Photo Chris Warren

at the same time. If we assume that 24-hour operation was required, then using an eight-hour shift system the crew would be – three operating, three sleeping and three cooking/resting, although the cramped conditions would make resting quite unpleasant. It is possible that a different shift system with just two crews could have been used.

The doorway to the left leads to the tiny galley or kitchen area which is equipped with its own head-height ventilation pipe and lighting plus a light switch.

Tunnel Corridor

Tunnel entrance. Photo Chris Warren

The tunnel entrance corridor is to the left and the wireless bays are located over to the right.

The Escape Tunnel

In common with other Auxiliary Unit bunkers, the station is equipped with an emergency exit in the form of a 22m tunnel constructed from 1.06m (42 inch) interlocking concrete pipes. A right-angle direction change is provided 17m from the dugout. Cable clips fitted by Bert Davis can still be seen today.

In 2001 Bert Davis (Royal Signals) wrote:

I spent many days fitting and wiring that station – one fact I will never forget is running electric wiring through the concrete pipes. I cannot remember the distance involved but I do remember fitting the cable clips with rawlplugs. In those days we had no drills or masonry bits, just a hammer and an old rawlplug punch. Blisters and backache bent up in a 48' (1.22m) diameter pipe."

The emergency escape tunnel. Photo Chris Warren

Cable clips inside the tunnel

LIGHTS OFF

Sign on the dividing wall outside the tunnel entrance

Tunnel Exit

A short distance beyond the original tunnel exit there are two long salt-glazed pipes. Exactly what these are for is not clear although an apparent lack of toilet facilities elsewhere in the dugout suggests it may be associated with some sort of chemical toilet. The walls immediately below the pipes are of a different colour which may be significant. The galvanised tank is assumed to have held water for some purpose.

The obvious problem with the toilet theory is that access must be through the 42-inch diameter tunnel. However, the choice is between an uncomfortable trip to the toilet or easy access to a much closer facility that would undoubtedly have created a bad smell and health hazard after a few days. A vent pipe can be seen on the ceiling and the two long pipes are assumed to be inlets. However, if the two long pipes are designed to remove smell from human waste products then the long pipes are more likely to be outlets.

Ventilation pipes near tunnel exit

Ventilation

The ventilation system in the Super Zero is more complex than has been seen elsewhere. Presumably the lessons learned from the construction and operation of the smaller Zero stations has been improved upon to achieve a better airflow throughout the dugout. This would be especially important if as many as eight or nine operators would be living underground for any length of time.

Some smaller Zero station dugouts were fitted with forced-air ventilation. The much larger Wilton dugout with a more complex system most likely had the same but no evidence of an extractor or inlet fan was seen. The main areas with ventilation were: sleeping quarters, wireless bays, generator bay, tunnel and the galley.

The 'standard' Zero station design provides outlet pipes near the roof of the dugout and inlet pipes near floor level. This makes use of natural convection although forced-air extraction is also believed occasionally to have been used. A feature not seen elsewhere is located in the floor just inside the entrance to the tunnel corridor.

Access hatch to ventilation chamber in the floor

A small removable lid covers an arrangement of salt-glazed pipes as seen below.

Ventilation chamber open

The author assumes that this is designed to minimise the distribution of sound originating from inside the dugout to the outside world. The current theory is that sound attenuation was achieved by simply de-coupling the pipes. The downward facing pipe is assumed to carry sound and by directing the flow downwards possibly onto a sound-absorbing surface such as a layer of dry leaves, the noise reaching the second pipe would be much attenuated.

Entry & Exit Hatches

Pulley-wheel for one of the hatches

Counterweight for hatch

The original entry and exit would have been covered with a heavy hatch operated by a system of weights and pulleys. Only one of these pulleys remains and is shown here resting on a bunk bed.

Diary entry Feb 8 1944

Salisbury (SATSO Conference) then to Hut where message to ring AG16 (o) – want confidential report on Doris and 5 officers are to be interviewed on Sat (12th). Spent a long time testing weights etc with Mr Gardner (?)

One of the counterweights for the entry or exit hatch can be seen lying on the ground outside the dugout.

Electrical Wiring

The station was provided with external mains power via a heavy duty armoured cable shown at the top and slightly right of centre.

Cable Distribution Panel

The five cables at top middle are feeder cables to the aerials which were most likely mounted in nearby trees. The base of a large felled or fallen tree can be seen today very close to the dugout. Five feeder cables suggest that five aerials were in use yet the Major Jones map suggests that only three wireless links were in operation in June 1944. This is perfectly possible because the removal of a link did not require the wiring to be altered.

The late ex-Royal Signals Cpl Arthur Gabbitas spent years researching the SD network. He was assigned to the Winchester Zero station during the war and was able to produce a map of the communication paths. Arthur included a link from Wilton to the Zero Station at Buckland St Mary which the Major Jones map does not show. The fifth link may have been to the Battle HQ at the now disused RAF Holmsley South airfield. This could be the station referred to by Sgt Alf Ellis as Battle.

Generator Bay

Exhaust box for generators. Photo Chris Warren

Typical Generator (not from this site)

Generator Door

The generator bay is designed to accommodate two generators sharing one exhaust box. Each generator was mounted on two rubber couplings to minimise noise and vibration.

This charging set is typical for the period. The photo is provided for reference only and is not associated with the Wilton station. Notice the central fixing point at the front.

A still functioning door viewed from the generator area leads back into the wireless room. The black material is anti-gas Union cloth soaked in oil to prevent carbon monoxide and any gas attacks from reaching the occupied areas beyond the door.

This view of the back wall with the generator bench to the left is probably where the batteries were stored and operated. The damage to the wall covering is believed to relate to the sulphuric acid droplets ejected from the cells during out-gassing.

Back wall of the dugout

ATS Hut

It was common practice for Zero Stations to be associated with an above ground hut and according to several of the ATS operators, they had instructions to decommission the hut of its wireless equipment and set up the station in the dugout when an invasion alarm was raised.

Bert Davis recorded the following in a letter to William Ward dated 5 June 2001:

In the early 1960's I visited the site in Hare Warren; it was very overgrown with shrubs and brambles, no sign of the tree trunk stump or hut that was the decoy nearby.

The hut was just fitted out as an office with a telephone. I had to tap into the phone line and ran concealed wiring to the buried Nissan (sic) hut. The GPO did visit the hut on one occasion and did not find my secret connection – perhaps they had been told not to be too inquisitive.

To the best of my memory there was only one exercise carried out – a number of ATS officers spent a few nights underground. I was reduced to sanitary duties. I think that the tunnel led to the Nissan hut – hence the electric cabling.

The suggestion here is that when Bert Davis was at Hare Warren the above-ground hut was not used to operate the wireless sets from. Other dugouts have been recorded as using tree stumps as covering for an entry hatch.

Network Function

It is no coincidence that the Wilton dugout is located in the grounds of Wilton House where the Southern Command HQ was based.

The following text comes from: www.bbc.co.uk/history/ww2peopleswar/stories/63/a4233863.shtml

L/Cpl Alice Catherine Hunt née Griffin ATS W/112190

On 30 October 1942 I moved to 3rd Command Signal Company, Wilton House, in Salisbury. This was where we worked again in shifts, in underground cellars in Wilton House, receiving signals through the teleprinters.

At Headquarters (HQ) teleprinters received messages (signals) constantly and these messages were then redistributed to their intended destinations either by teleprinter, telephone or despatch rider, some of whom were ATS.

Most of the signals were Orders and during a particularly busy period many came through with the name Overlord on them. These were in code and had to pass through the cipher office before they could be issued.

The following text is from:

www.wiltshire-opc.org.uk/Items/Wilton/Wilton%20-%20Army%20at%20Wilton%20&%20Erskine%20Barracks.pdf *(replace '%20' with a space)*

During the Second World War Wilton's links with the Army were renewed. Wilton House was requisitioned as the new HQ of Southern Command; Nissen huts were set up in the grounds and used as extra offices and accommodation. The Pembroke Arms Hotel became the Officers Mess and what is now the Estate Office was a canteen run by Lady Pembroke and a team of helpers.

Much of the planning for D-Day was done at Wilton House; Southern Command stretched from Sussex to Land's End. Communications were vital and 750 miles of telephone wire was laid in and around Wilton House, linking the centre of operations with all units in the area.

After the war, Southern Command stayed at Wilton House until 1949 when the Army purchased Fugglestone House (part of the Wilton Estate). The American Army had used Fugglestone as their Southern Command Field Base during the war. Erskine Barracks utilised the existing buildings and built extensive new office accommodation in the early 1960s.

©Wiltshire OPC Project/2014/Eileen Barnett

Some of the equipment used for this network has been identified for type and function. A list follows:

Batteries

The stations used transmit/receive wireless sets which operated from 6V DC using car batteries. Obviously the technology of the day was thermionic valves and the high-tension supplies required were provided by DC to DC inverters.

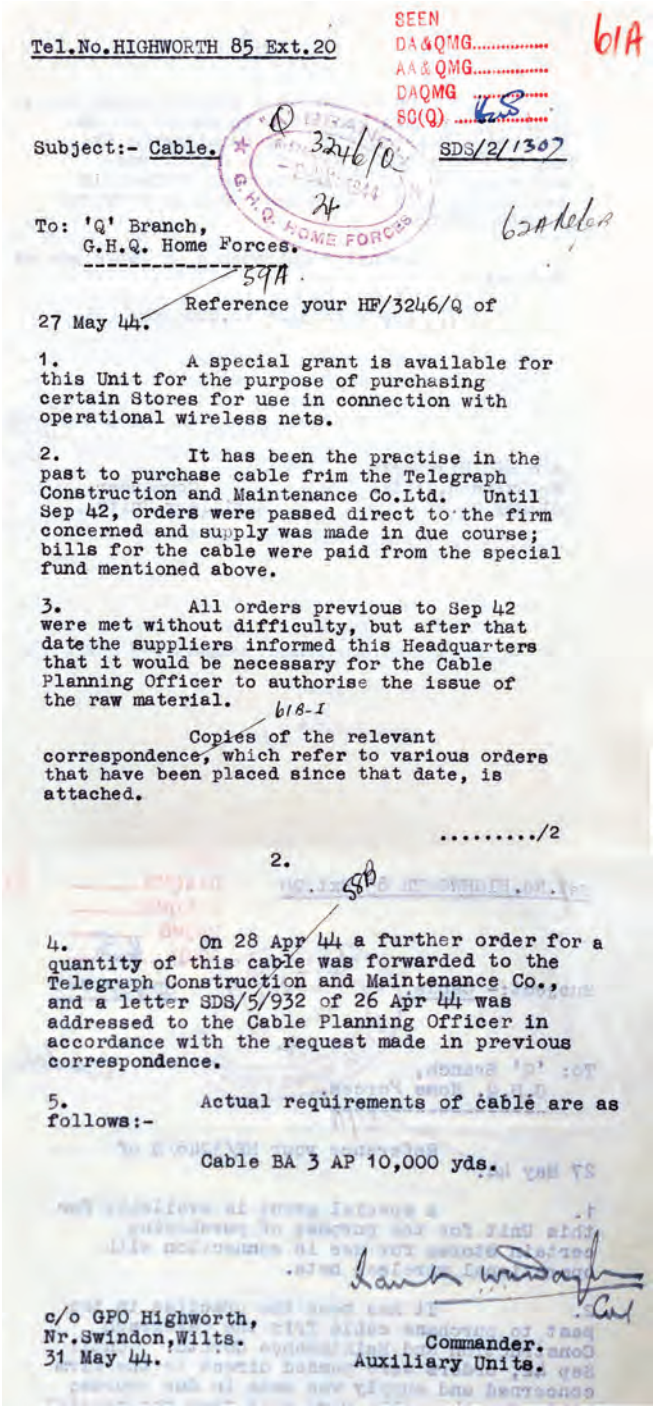
Wireless Feeder Cable

Trivial one may think but reducing the size of the cable used between a VHF set and its associated remote aerial was a major headache in 1939/1940. The problem was solved using a two-core balanced 80-Ohm feeder cable identified as BA 3 AP and manufactured by the Telegraph Construction & Maintenance Company.

The following communication is copied from TNA document bundle WO/199/937

The reason this cable was able to achieve an impedance of 80 Ohm is that the classified insulating materials used had a very high dielectric constant. The author believes this material was polyethylene. A detailed account of the development of this material is available on Wikipedia but this section is interesting:

But because of World War Two, commercial production was halted and secrecy imposed and the new ICI process was used to produce polyethylene for insulation of wires and cables in radar sets.



SEEN
DA&QMG.....
AA&QMG.....
DAQMG .....
SO(Q) .....

61A

Tel.No.HIGHWORTH 85 Ext.20

Subject:- Cable. SDS/2/1307

To: 'Q' Branch,
G.H.Q. Home Forces.

Reference your HF/3246/Q of 27 May 44.

1. A special grant is available for this Unit for the purpose of purchasing certain Stores for use in connection with operational wireless nets.

2. It has been the practise in the past to purchase cable frim the Telegraph Construction and Maintenance Co.Ltd. Until Sep 42, orders were passed direct to the firm concerned and supply was made in due course; bills for the cable were paid from the special fund mentioned above.

3. All orders previous to Sep 42 were met without difficulty, but after that date the suppliers informed this Headquarters that it would be necessary for the Cable Planning Officer to authorise the issue of the raw material.

Copies of the relevant correspondence, which refer to various orders that have been placed since that date, is attached.

...../2

2.

4. On 28 Apr 44 a further order for a quantity of this cable was forwarded to the Telegraph Construction and Maintenance Co., and a letter SDS/5/932 of 26 Apr 44 was addressed to the Cable Planning Officer in accordance with the request made in previous correspondence.

5. Actual requirements of cable are as follows:-

Cable BA 3 AP 10,000 yds.

c/o GPO Highworth,
Nr.Swindon,Wilts.
31 May 44.

Commander.
Auxiliary Units.

It is difficult to imagine why the request was made as late as 31 May 1944 requesting an enormous 10,000 yards of the cable.

The Wireless Sets

Perhaps the most interesting items in the stations were the VHF communications sets now generally known as the TRD. These sets were relatively small, light, and easy to operate. Also, they required only a single 6-volt car battery for power. More importantly, according to Captain Ken Ward they used a 'quench' modulation technique making them difficult to intercept.

Aerials

The tree-mounted pre-assembled aerials were made from copper tubing. Indoor aerials were very simply constructed on-site by stripping back the two insulated

conductors and laying the cable out in the shape of a 'T' mounted broadside to the direction of propagation.

Operational Purpose

It is clear that the Wilton Super Zero Station was opened a few months before the network was closed down in July 1944. One may ask why work continued when fear of an invasion was long past and the originally intended stay-behind function could no longer be fulfilled.

As with all engineering and construction projects these things have inertia and sometimes it is easier to continue than it is to stop. Also, the SD network played a part in the preparations for D-Day and Wilton may have been useful in that regard. The cost to complete a project of this size would have been insignificant compared to the overall D-Day commitment.

What Next?

The evidence from smaller but similar Zero Stations makes clear that this unique structure will eventually collapse. How long this will take is difficult to predict. Fortunately the general condition of the main corrugated section, although very heavily corroded, is intact. The timber-constructed chamber near the blast door is of wood construction so is likely to go first as it has already done to some extent.

With sufficient time, money, and of course permission from the landowner, it may be possible for this unique example of Britain's WWII secret history to be preserved. However, at the present time this is most unlikely and eventual collapse is sadly the expected fate for this station.

Historic England Listing

The importance of the site has been recognised by its scheduling as a Site of national importance. There's no better summary and conclusion than to quote from the key part of the scheduling:

> The underground wireless station in Hare Warren Woods, Wilton was constructed in 1943/4 as part of a secret military organisation to operate in areas of Britain should they come under German occupation. With the increasing threat of a German invasion in the summer of 1940, the Prime Minister, Winston Churchill, directed that a covert Army unit called 'GHQ Auxiliary Units' was to be formed. This has sometimes become referred to as the 'British Resistance Organisation' or BRO. The Operational Branch of the unit trained and equipped civilians to carry out acts of sabotage behind enemy lines.
>
> A completely separate branch called 'Special Duties', to which this station belonged, trained civilian volunteers living in the most threatened coastal areas of Britain to act as 'observers' (spies) and report on German military activities from within occupied areas. Observers left their reports in 'dead letter drops', which were delivered by runners to hidden wireless stations, called 'OUT-Stations'. Civilian operators would then transmit the reports to military manned 'IN-Stations' outside the occupied area. The wireless networks were set up by Royal Signals from the GHQ Auxiliary Units Signals. The IN-Stations were manned by specially selected signallers or by officers of the Auxiliary Territorial Service (ATS).
>
> Many of these IN-Stations were sited near to the Division or Corps HQs responsible for the operations in that area, and reports were delivered to the nearby HQ by runner or telephone. Initially, IN-Stations worked from wooden huts near to the HQ which they served, but from 1941 onwards many were provided with concealed underground dugouts. These were equipped with rations, water, sanitation and power supplies so that if the Germans occupied the surrounding area, they could remain concealed and operate in isolation for up to 21 days.
>
> Considerable ingenuity was used to conceal the entrances via trap doors and locking mechanisms. Special ventilation systems were built to provide fresh air in the dugout and to disperse foul air, generator exhaust fumes or cooking smells while muffling the sounds of activity and the noise of the generators. Aerials were concealed in nearby trees and the feeder cables were hidden under the bark. If access was gained into the dugout by the enemy, a layer of security was provided by heavy concealed doors, which gave time for the crew to destroy sensitive material and hopefully escape via a special tunnel with a hidden exit.
>
> Royal Signals set up 20 wireless networks, each with an IN-Station (sometimes called a Control or Zero Station) to collect the intelligence reports transmitted from the OUT-Stations, which in most cases were near to the coast. Initially, the wireless coverage was in Kent, Surrey and East Anglia but there was a steady expansion northwards up the east coast, eventually to Sutherland and Caithness. The networks also expanded westwards along the South Coast from Hampshire through Dorset, East Devon, Somerset and along the South Wales coast. The station at Hare Warren appears to have been operational in a hut from March 1942 or earlier and evidence suggests that Wilton was the only command HQ to eventually have underground facilities.
>
> Contemporary documents indicate that the dugout was constructed in late 1943 and early 1944, when the threat of invasion was extremely low although there was still the possibility of German airborne or seaborne raids, but only near the coast. A reference to a 'super station' by Senior Commander Beatrice Temple (ATS), in her diary, probably refers to the station at Hare Warren: it is approximately three times the size of any other known IN-Station and accommodated 8 or 9, rather than 3, operators.
>
> This IN-Station is of particular significance as it was an 'Inner Network' Station (collecting intelligence

via IN-Stations rather than directly from OUT-Stations) serving the headquarters of the Army Southern Command, which had requisitioned Wilton House for its HQ and was responsible for the coastline from Portsmouth westwards to Lands End, and along the Bristol Channel into Gloucestershire. Documentary evidence in the National Archives (WO199/1194) shows it had direct wireless links from IN-Stations at Blandford covering the Dorset coast and Winchester covering Hampshire, plus another link to Coleshill, which gave indirect access from IN-Stations covering Somerset and East Devon. Coleshill House was the headquarters of the Auxiliary Units. There was also an alternate route from these stations via the Blandford site to Wilton.

By July 1944, approximately 3,500 civilians had been trained and the wireless networks were operating with over 125 civilian-operated OUT-Stations (and 78 SUB OUT-Stations), most of which were concealed in dugouts or hidden behind dummy walls in houses, attics, sheds or other buildings. Special Royal Engineers teams were used for this secret work. There were c.30 IN-Stations, most of which were also linked to an 'INNER Network' which enabled the intelligence to be passed back to Army District or Command HQs.

The Special Duties branch was closed down in July 1944 and orders were given that all equipment was to be removed from the stations, and the concealed dugout entry and exit shafts were to be capped off with concrete and covered with earth. By 18 September 1944, documents in the National Archive (WO199/1194) report that all IN and OUT stations had been dismantled and closed down and that all dugouts had been blocked off. Between July and September 1944, the main entrance at Hare Warren was sealed with a concrete slab and covered with earth to conceal the facility and prevent access to it. The structure, its constructional details, and its facilities were to remain a secret in case the special techniques were to be required at some point in the future.

In 2013, the Wilton Control Station remains intact with steel grilles fixed across the two entrances. One area of roof has collapsed, possibly through human intervention.

From:

https://historicengland.org.uk/listing/the-list/list-entry/1417594

Photos by Brian Drury unless stated

Bruniquel Cave – the earliest known man-made structure on the planet

Linda Dixon

Bruniquel is a tiny village near Montauban in the Midi-Pyrénées region of southwestern France. There are several caves in the area and I came across an article about the fascinating Bruniquel Cave in the Newsletter (September 2016) of the William Pengelly Cave Studies Trust.

Each ring is made up of pieces of stalagmite roughly the same size, with structures having chunks stacked on top of each and in some cases supported by other pieces.

Discovery

The ancient cave was discovered by a 15-year-old boy in 1990. He dug a 39-metre long passage through a rock pile, in pursuit of a draught, and came across a sizeable collection of chambers. Archaeologists then investigated the cave, which had closed naturally during the Pleistocene.

Over 300 metres into the cave the explorers found structures made of stalagmites which had been broken off and interlinked. Some 400 pieces had been arranged into two rings – a large one between four and seven metres across and a smaller one, just two metres wide. Loose stalagmites had been propped up against these and there were four piles that were not yet arranged. Traces of fire were everywhere and there was a mass of burnt bones.

Early research

During the investigation, great care was taken to preserve the natural formations. In addition to the stalagmite circles, there were flowstones, an underground lake, calcite rafts, bone remains and dozens of bear hibernation hollows in pristine condition. A thick layer of calcite coated all the structures, making dating difficult but the archaeologists at the time came up with a date of 47,600 years old.

The latest studies

In 2016 Jacques Jaubert of Bordeaux University led a team to carry out a scientific appraisal of the structures. They used Uranium-series-dating which gave an astonishing age of 176,500 years before present, making the circular stalagmite structures the oldest known hominid construction on the planet. This corresponds to a time when early Neanderthals were the only humans in the area at that time, and therefore they must have been the builders.

Jaubert said, "The most surprising element of the research was finding signs that the early Neanderthals had succeeded in mastering the underground environment. The location and topography of the structures are key here. They are far from the entrance and the light of day, which suggests that these people were organised, had skills to enter deep into the cave and to transport materials inside it as well as to light it up."

The discovery shows that early Neanderthals were capable of building more elaborate structures than previously realised, and that they had a more complex social organisation than previously thought.

References:

William Pengelly Cave Studies Trust *Newsletter No. 123*, September 2016

Wikipedia*:* https://en.wikipedia.org/wiki/Bruniquel_Cave

Jaubert, Jacques et al:"Early Neanderthal Constructions deep in Bruniquel Cave in Southwestern France". *Nature 534* ISSN 0028-0836.

Sub Brit Site Visit to RAF Barnham, Suffolk

Chris Rayner

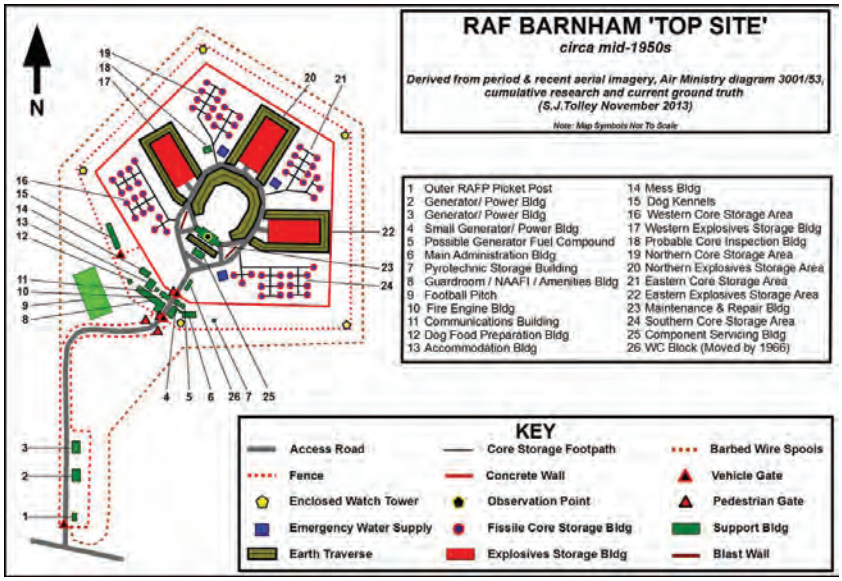
Non-nuclear Component Building 60 and its refurbished gantry seen from the opposite berm. The steel joist runway beam for the hoist can be seen

Aerial view of Barnham in 1955

In the wild Breckland Country of the Suffolk/Norfolk border in the early 1950s, building work was in progress. Part of the wartime mustard gas storage site was being developed as RAF Barnham (94 Maintenance Unit) Nuclear Bomb Store, and a very secure compound was being built. This would have two outer wire fences, topped with barbed wire and with regular dog patrols between, an inner concrete panel wall, and then 12m high earth bunds. There would also be a number of large buildings.

Would-be bird watchers in the area were rapidly seen off, or worse, and local people were left guessing about what went on within the fences, although a story about training chimpanzees for space flights got some traction and may even have been deliberately started by the authorities.

Blue Danube bomb at Barnham. It had a similar explosive power as those dropped on Japan – about 16,000 tonnes of conventional high explosive



Plan by Sam Tolley from RAF Barnham web site http://rafbarnham-nss.weebly.com/

This was, however, Britain's first assembly and storage site for nuclear weapons.

"We've got to have the bloody Union Jack on top of it"

Britain's nuclear weapons programme began in earnest in 1947 when the Labour government realised that our great wartime ally, the United States, had enacted a new law, the McMahon Act, to deny Britain access to the nuclear weapons that British scientists had played such a great role in developing. Labour Home Secretary Ernest Bevin is said to have demanded "We've got to have this thing over here, whatever it costs. We've got to have the bloody Union Jack on top of it."

William Penney, a British physicist who had been a key member of Project Manhattan, the Allied atomic bomb project during the Second World War, was asked to build Britain's first nuclear weapon based on his memories of that period. The result was Blue Danube, a 24ft-long (7.3m) bomb weighing 10,000lbs (4,636kgs) that would need to be delivered by one of Britain's new V-bombers (Vulcan, Victor and Valiant).

As well as the need to build and test a bomb, to build the V-bombers and their dedicated airfields, and to train the necessary personnel, there would also need to be a place where the first bombs could be kept and maintained. This is where 94 Maintenance Unit at RAF Barnham came in, and why a group of twenty SubBrit Members were assembling on a brisk Saturday morning in November for a site visit. (A second group assembled on the following Saturday, although this time it rained most of the day.)

The site, in plan form, has echoes of 19th-century and earlier military forts, with its pentagonal shape and layers of defences. There are the outer and inner wire fences, the inner concrete-plank fence, and the earth ramp wall already mentioned. These defences were bolstered with, at first, wooden watchtowers, and then in 1959, five taller steel-framed watchtowers complete with searchlights, located at the corners of the inner wire fence.

There were regular dog patrols, and as can be seen from the plan on the SubBrit website, dogs were an important element of the complex design, with a dog pound and even a building dedicated to the preparation of dog food. The dog handlers were the only personnel who stayed on site, day in, day out. Their vigilance meant that only one person ever breached the outer wire fence, but then he was quickly apprehended.

Confusing the Russians

The use of the site was a well-guarded secret from local people and the wider British public, but was very visible from spy planes and, later, satellites passing above. That was intentional though, for a deterrent is only useful if one's enemy knows about it and believes in it. Particularly if they believe it to be a more powerful deterrent than it really is.

A cluster of buildings at the site entrance seen from the entrance watchtower projecting timber platform. The large brick building on the left was another inspection and repair workshop, but probably for non-explosive material given the absence of blast walls. Maintenance Building 58 is to the rear of a Component Servicing building in the centre of the photo, and a toilet block is to the right in the foreground

Inside the earth ramparts were laid out three large buildings in a fan shape, served by a small ring road. Between these were four branched groups of small huts, called "hutches". In addition there were buildings of

Group of hutches on the north side of the complex

various sorts clustered around the only entrance road, both between the two wire fences, and also inside the inner concrete panel fence where few of even the site staff would have entered.

The most interesting structures that Khrushchev's advisers would have speculated about would have been the 57 "hutches" arranged in four groups. The layout of these is quite unique and would have been quickly interpreted as storage units for fissile material, as indeed they were. There were two types of hutch, one used for plutonium cores and the other, it is believed, for cobalt cores.

Both had keyhole-shaped recesses in their floors; however the latter had a pair of recesses and as a result the hutches were slightly wider. The radioactive material would have been stored in metal containers called "safes", which were then set into these recesses in the floor slabs. The heavy lids had a counterbalance and moved sideways. The hutches were linked in groups by concrete paths with distinctive galvanised tubular-steel railings on both sides to facilitate access

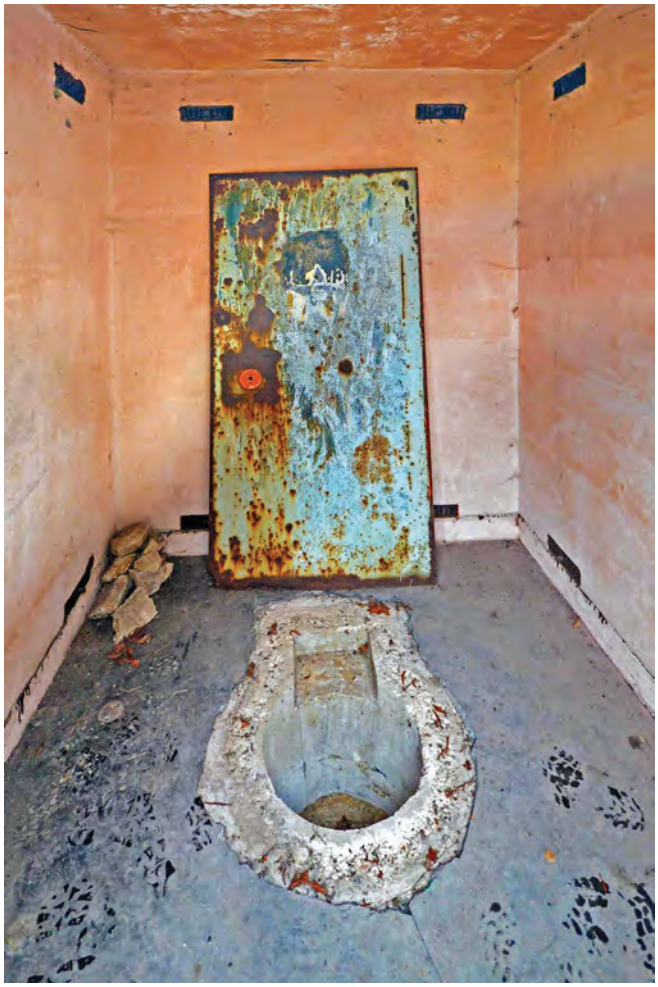
Outside the hutch, showing the replacement door (an identical replica) locking mechanism. The writing to the right of the door refers to the most recent lightning conductor test (possibly April 1963). Electric power and isolation to the left of the door

Two-Man Rule

A hutch would be accessed by a pair of site personnel, each one having the means of opening one of the two locks (Manifoil combination lock to the entrance door, and key-operated lock to the safe), to ensure that no single person could access one of the cores.

On opening the door, a large spring-loaded electrical door contact would trigger an alarm and all persons on site were expected to freeze exactly where they were for the several seconds it would take the NCO to enter the hutch and make contact with the Control Room who would then turn off the alarm. Quite why all personnel were required to stand still for a short time is not known.

The three large blockhouses that separated these groups of hutches were the non-nuclear component stores, and each one was separated from its neighbours and from the hutch clusters by high earth bunds to make sure that an accidental explosion in one would not take out any others.



Inside one of the hutches – the faint A on the original steel-faced door identifies the hutch as type A, storing a plutonium core, which is confirmed by the single "safe" set into the middle of the floor

It was within these blockhouses that the high-explosive components and the Blue Danube, and then later Red Beard, bomb casings were stored, and where the bombs were maintained.

Side view of Non-nuclear Component Building 60's gantry, which was required to lift and manoeuvre the massive Blue Danube bomb onto a bomb trolley for wheeling into the building

The buildings were open-plan although notionally subdivided into compartments of 11 x 3 bays following the column grid, allowing the storage of up to 66 bombs. To ensure a stable environment they were air-conditioned,

The roof of the central Non-nuclear Component blockhouse showing the reinforced concrete framed construction, the roof and its central air conditioning duct, and at the far end the raised lifting gantry

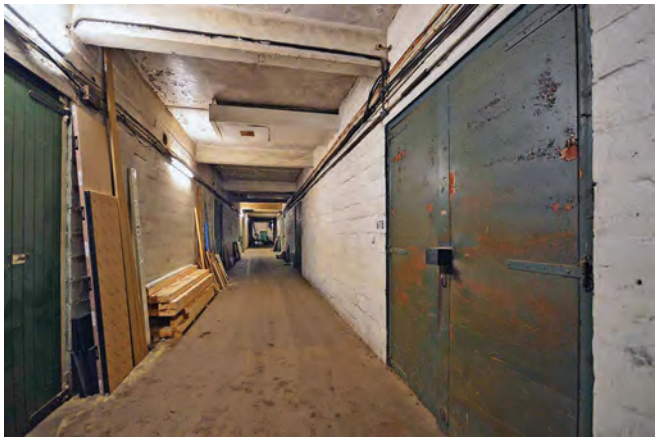
with a large duct running centrally above their flat roofs which was fed from plant and switch rooms flanking the building's 3.0m wide x 3.5m high heavy steel doors.

Projecting out the front of the buildings were roadside external gantries and machinery that allowed heavy elements to be lifted off trucks and then wheeled into the adjacent buildings, and then the converse when the reassembled bombs were being transferred off-site. The need for this time-consuming process was because the high-explosive component was prone to shrinkage and required very regular maintenance.

These and other buildings on site would have served the southern V-Force bomber airfields, while a slightly later duplicate of the site, at Faldingworth in Lincolnshire, housed 92 Maintenance Unit covering the northern bases.

The main entrance doors of Non-nuclear Component Building 61 (the easternmost of the two). Plant rooms flank the entrance, while above, repairs to the roof and to the gantry concrete are in progress

Having the bombs stored at a distance was not a satisfactory arrangement and explains why the site was in use for such a relatively short period of time, from around 1957 when it was completed (it was built between 1952 and 1955), to its closure in early 1963. Its demise was as a result of improvements to bomb design that meant they needed less maintenance and could now be kept on air bases, readily accessible to the bombers that would



The central passage in Non-nuclear Component Building 61 showing regular downstand reinforced concrete beams and air conditioning duct outlets at high level

carry them. But the days of free-fall nuclear bombs were also numbered, as missiles, like Blue Steel, came into service, but that is another story…

One's very own nuclear bomb site

The site became redundant and was decommissioned in the early 1960s and returned by the MoD to the previous owners, the Guinness Trust (Earls of Iveagh) which owns much of the surrounding territory. That is when our host for the day, site owner Keith Eldred, first came to hear of it.

The site had failed to sell at auction with a reserve price of £45,000 (£800,000 in today's money) and Keith, a chartered surveyor living in Thetford, was intrigued, as it looked a very attractive prospect, being a 23-acre site with around 50,000 sq. ft. of accommodation. Speaking to the Agents and asked to come up with an offer on the spot, he offered £20,000 without realising that this was the absolute minimum the Vendors would accept. "Done", said the Agent. Keith hadn't expected his offer to be accepted, and now had to find the funds. He managed, however, and he and his wife Margot became proud owners of the site in March 1966.

Keith Eldred proudly displays his replica Blue Danube bomb which doubles up as a vehicle directional sign. The Component Servicing building is at the right of the photo, and to the rear is Maintenance Building 58

Their plan was to use the three large blockhouses to grow mushrooms in, and they subdivided the originally

open-plan buildings with concrete block walls, creating a central passage with smaller rooms on both sides. Later these rooms would become individual workshops and stores that would be rented out to tenants, as would the other large buildings on site as the site began a new life as a light industrial estate. Unfortunately the mushroom farm later failed when a virus wiped out the entire stock.

The open areas of the site were used to grow Christmas trees and a few mature reminders of these still remain on site, "the ones that didn't sell" as Keith described them. In recent years he has carried out a lot of tree clearance to try to get back to the site's original openness.

Over the years there have been other changes. The westernmost non-nuclear component store, at that time being rented out to a somewhat difficult tenant and full of plastic to be recycled, caught fire, completely destroying the building, which was not subsequently rebuilt. Fortunately there was an insurance pay-out.

English Heritage wades in

More profound changes though, would take place when English Heritage/Historic England realised how important the site is, and started to work with Keith on its preservation. The concrete panel fence is illustrative of the conservation problems.

Fire Station to the left and Generator building 70 to the right of the Middle Gate through the inner wire fence. The southern watchtower is to the rear

Inside the refurbished entrance watchtower where traces of a ladybird invasion can be seen. A triangular panel in the foreground of the floor is the small hatch by which one reaches the observation platform

Over the years, the concrete cover to the metal reinforcement within both the posts and panels had spalled off and many panels had fallen. English Heritage's solution was to fix metal posts on both sides of the concrete posts to hold the panels on, using stainless steel cleats to strap them all together. Not only very costly, a serious consideration considering the one-kilometre length of the fence, but also unsightly. Keith, however, came up with a much simpler stainless-steel plate fixing, which looked much more elegant and more than halved the cost.

Four of the watchtowers have been comprehensively repaired, treating and redecorating the steelwork and repairing the timber enclosure on top, while the fifth has been surrounded by safety fencing and left to age naturally and no doubt collapse eventually. For many of us, this was one of the most poignant parts of the visit

Core Inspection Building with its 0.7m thick surrounding blast wall

We also looked at Keith's former office, the original Core Inspection Room for the complex where radioactive material was inspected and could be temporarily stored in a floor safe (the only one on site that was not located in a hutch).

As this was in the most dangerous part of the site, it has a brick blast wall on the three most exposed sides, and because the brickwork is decaying badly, English Heritage's consent was needed to be allowed to repair the upper sections in new matching flettons to ensure that it would survive a little longer. The resulting six courses of new bricks on top of an old wall look a little odd.

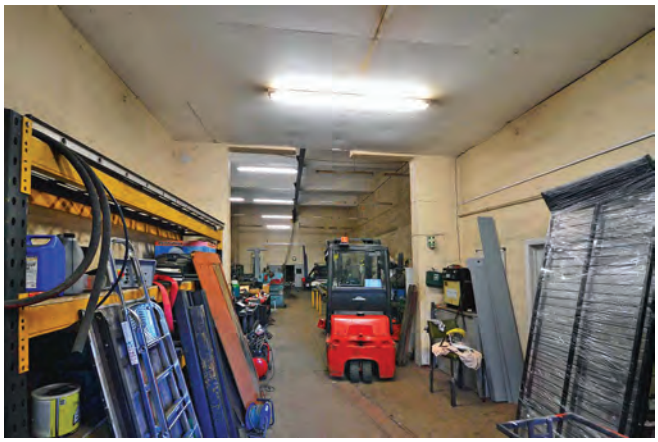
Doors not what they seem

Meanwhile, many of the "hutches" needed new doors, which were built to replicate the original rusting metal-faced timber doors. The only change was that they were given an acrylic cover which replicated through photography the appearance of the original doors, complete with the semblance of peeling paint and rust. Where these were replaced, the original decayed door was saved and propped up inside the hutch.

All of the floor safes had been removed when the site was decommissioned. Keith took us to one hutch, however, that had two recesses in its floor, both of which contained

safes obtained recently from RAF Waddington. The presence of *two* safes indicates that the hutch might have been used to store the cobalt that was apparently used for testing the high-explosive material.

Maintenance Building 58 was one of two buildings on the site used for the inspection of bombs brought from the airfields (called Maintenance and Repair Building on the plan). It was a drive through building, with large double height steel doors at each end, and thus didn't need overhead gantries. A concrete retaining wall at the left of the picture provides a cutting and curved traverse through one of the earth berms This view shows the large entrance doors at the east end. This building used to have a RAF Police watchtower on its roof



Rare view inside Maintenance Building 58. The foreground vestibule used to incorporate an airlock, while the central section of the building, beyond the wall nibs, has a ceiling mounted runway beam which originally supported four hoists

The two surviving Non-Nuclear Component Stores are surrounded on three sides by earth ramparts to absorb the blast of any accidental explosion. The roof and walls are independent of one another, with the intention that the blast would blow out the walls, rather than the roof – exactly the opposite of most explosive stores.

It is difficult to get an impression of their original appearance internally, as a single large open place with a grid of columns, since the blockwork subdivision walls built in the late 1960s close up the view. From above, the newly repaired roof finish is apparent, as well as the original raised spine that houses ventilation ductwork.

A large amount of work has gone into repairing the reinforced concrete gantry, which has included removing any spalling concrete, exposing and treating any corroded steel, and then repairing the concrete in such a way that original timber board marks are replicated. Only the central store building has so far been repaired in this way, while its neighbour to the east is presently buried in scaffolding.

We finished our three-hour tour all too soon, with a couple of short films and tea and coffee kindly provided by Margot. Keith then asked if anyone would like to climb up the main entrance watchtower and was overwhelmed by the sea of raised hands – a great end to a tremendous visit.

Looking southwest from the entrance watchtower to a cluster of buildings between the two wire fences, including Fire Station, Guardroom, RAF Police Billets, Gym, NAAFI and Dog Food Preparation buildings (the latter two often confused!)

Our grateful thanks to Keith Eldred for showing us his site, for his anecdotes, and for all that he has done to ensure this unique site's survival.

All colour photos by Chris Rayner

Further information

www.subbrit.org.uk/rsg/sites/b/barnham_nuclear_bomb_store/index.html

https://en.wikipedia.org/wiki/Blue_Danube_(nuclear_weapon)

www.gorseindustrialestate.co.uk

http://rafbarnham-nss.weebly.com/ RAF Barnham Nuclear Weapons Storage Site

COLD WAR – Building for Nuclear Confrontation 1946–1989, Wayne Cockcroft and Roger Thomas, pub. English Heritage 2003, ISBN 9781-873592-816, pages 29–33.

Southernmost of the Generator/Power Buildings

International Mining History Congress: Linares, Spain

Robert Barnes

Linares Landscape

The 11th International Mining History Congress took place during September 2016, based in the town of Linares, Spain. Over one hundred delegates, from across the world, arrived in good time to book into many of the hotels in this mining town, and later, to register at El Posito, in the town centre, on Monday morning September 5.

The format of this year's congress was visits by coach to various mining sites around Linares, during the mornings, with lectures and presentations in the theatre at El Posito Museum during the afternoons. Coffee breaks, lunch and dinners all part of the day's labours!

Lectures included explaining the development and decline of the mining for lead in the area; the evolution of health and safety regulations with respect to mining; and talks on mining in Australia, Mexico, Poland, Bolivia, Germany and India.

Linares is an industrial town over four hundred metres above sea level in the south of Spain, in the Andalusian province of Jaén. Lead mining has been known in the area from as far back as the third century BC. As well as being the birthplace of classical guitarist Andrés Segovia, Linares is perhaps best known in Spain for the bullring where the famous bullfighter Manolete met his death in 1947.

A warning sign to take heed of

The area around Linares was recognised, from the mid-nineteenth century to the beginning of the twentieth century, as containing some of the world's major lead producers. The Tortilla Mine Concessions totalled 26, with seven principal shafts on the North Vein, and 17 on the South Vein. A system of narrow-gauge railways linked many of the mines.

The Tortilla Mine reached a depth of some 240 metres. The two elderly Cornish pumping engines were having problems pumping at this depth, so engineer Reginald Bonham Carter decided to install 'Worthington Pumps'. The pumping system was installed in a new shaft, sunk

Cornish Influence at Linares

close to the San Federico Shaft. It was designed to take the steam pipes down to a triple expansion engine, and take a 10-inch rising main, to conduct the water from the mine. This engine was in a new chamber at a depth of 240 metres.

The water these days is still pumped out, and used by local farmers to irrigate the almond trees. With early morning starts so that delegates could be back in time for lunch, and afternoon lectures, the coffee breaks mid-morning were a welcome sight. No matter how remote

Time for coffee

the mine, and how many fields were trudged through to reach workings, shafts and head-frames, as if by magic, just around a corner, would be tables groaning with fresh fruit, cakes, cold drinks, tea and coffee, all served by waiters that would not look out of place at a posh hotel in London's Park Lane!

Next year's International Mining History Congress will be in Chile, with New Zealand being looked at for 2018.

For more information on the mining area of Linares:

Thomas Sopwith Jnr. (ISBN 9780-901450-692), Robert W Vernon.

Don Regino (ISBN 9781-849148-962) , Robert and Margaret Vernon.

William Constable and England's oldest surviving road tunnel at Reigate, Surrey

Last July [1984] Surrey Record Office [now Surrey History Centre] purchased at auction at Sotheby's the account and working notebook of William Constable, surveyor of Horley and Reigate. The notebook covers the period 1815 to 1837. It is feintly ruled as a cash book and the entries consist of notes of work done and the charge made, probably in the form in which the account was submitted to the client, together with additional notes in some cases. The entries are crossed through, presumably when payment was made, or perhaps when the account was sent.

Much of the work was done for Ambrose Glover, Attorney, Clerk to the Turnpike Trust and Steward of Reigate Manor, and much for the Trustees of Reigate Turnpike, but Constable's clients include a wide range of local gentlemen. Entries relating to further afield include an estimate for improving the roads from Brighton to Shoreham, 8 June 1821, and a survey of the Bridport Turnpike between Beaminster and Whitley Cross, August to October 1829.

Two of the major works carried out during Constable's period as Surveyor to the Turnpike Trust were the cutting of a tunnel road through the grounds of Reigate Castle, 1823, and the construction of a suspension bridge over the cutting at the top of Reigate Hill, 1825. Several of Constable's accounts relate to the tunnel road and they include an account of 17 October 1823 for a second set of plans and elevations of a toll house 'agreeably to precise instructions from Mr. Glover for an antique style in the external appearance.' Several accounts for the proposed improvement of the road over Reigate Hill are included, although so far no specific reference to the suspension bridge has been noticed. The notebook complements records of Reigate Turnpike Trust and plans by William Constable already in the Record Office.

It seems that Constable was born at Horley in the late eighteenth century, son of the village miller. He was apprenticed at Lewes, Sussex, and commenced a drapery business in Brighton in 1802. Hooper's Reigate gives a fascinating summary of his life, including surveying in the U.S.A. between about 1806 and 1812, and recounts that after resigning as Surveyor to the Reigate Turnpike Trust Constable settled in Brighton, where he was the sole practitioner of Daguerrotype photography. He developed, for a 'flying' stunt at the Pleasure Gardens, what seems to have been an ancestor of the 'breeches buoy.' These aspects of his life have, however, not been investigated in detail: the notebook itself is the sober record of a local surveyor's professional work.

[Note: Dr. David Robinson was in 1984 County Archivist of Surrey County Council]

SOURCE: ROBINSON, David, 1984, The notebook of William Constable. *Newsl. Surrey Industrial History Group* 24, page 7 [The notebook is held with the archives at the Surrey History Centre in Woking]

Discounted Cotswold Shopping

Cotswold Outdoor have granted Sub Brit members a 15% discount on their products (excluding sales and special offers). The details are included in a letter on the website at www.subbrit.org.uk/docs/discount-cotswold-outdoor.pdf

If you are not able to access the website, then please contact us with an SAE for a copy of the letter.

The discount code can be used in any of their 58 stores (there is a barcode on the letter), and for telephone and online orders.

**** Please do not share or abuse the code as this may lead Cotswold to withdraw it which would be a great shame and spoil things for the rest of our members. ****

Here is an introduction from David Hague of Cotswold:

"Cotswold Outdoor are proud to be a supporter of such a prestigious organisation as Sub Brit. As most of your members are aware, Cotswold Outdoor is a multi-award winning retailer with numerous thriving stores located nationwide. Not only are we proud of our knowledgeable staff, but our stores stock one of the most comprehensive ranges of outdoor clothing and equipment in the UK. With a huge range of footwear, waterproof jackets and fleeces, tents, sleeping bags and outdoor accessories, we offer one of the best selections of clothing and equipment right on your doorstep.

Whoever you are and whatever you need, when you shop with us you can be assured of expert, award-winning service and advice that comes from 40 years of experience in retailing. We're really looking forward to welcoming you to our store, online or over the phone soon. I hope that our discount helps your members purchase the right kit and equipment as they continue with their important and valued pastime. We are passionate about giving the right advice and recommending the right clothing and equipment so you can have peace of mind while out in (or should that be under!) the field."

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